HOME OFFICE.

REPORT

ON

SAFE-GUARDS FOR THE PREVENTION OF ACCIDENTS

IN

THE MANUFACTURE OF COTTON.

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BY

H. S. RICHMOND,

One of His Majesty's Superintending Inspectors of Factories.

Presented to both Houses of Parliament by Command of His Majesty.

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on 24 February, 2020

HOME OFFICE,

15th August, 1906.

SIR,

I BEG to submit a Report from the Superintending Inspector for the North-Western Division, upon the prevention of accidents in the spinning and weaving of cotton. Mr. Richmond and the Inspectors under his direction have given close attention to this important industry for several years past, and he is now able to add materially to the information contained in the earlier Report on the same subject which he in conjunction with Mr. Beaumont prepared in 1899. As the Report will be of service not only to the Department but also to manufacturers of cotton and to the makers of the machinery they use, I recommend that it be presented to Parliament and published.

I have the honour to be,

SIR,

Your obedient Servant,

ARTHUR WHITELEGGE,

Chief Inspector of Factories.

The Right Honourable

Herbert John Gladstone, M.P.,

His Majesty's Principal Secretary of State

for the Home Department.

1500 Wt 8578 9/06 D & S 4 25546

72, Bridge Street,

Manchester,

June 18*th*, 1906.

Sir,

In accordance with your instructions I beg to submit the following Report on the requisite steps to be taken for the provision of safe-guards in cotton-spinning and weaving factories. The Report on the same subject, published in 1899, was of a more or less tentative character, and is now, owing to subsequent legislation, somewhat out of date. The present Report is based upon the requirements of the Consolidating and Amending Factory Act of 1901, and upon the results disclosed by the statistics of accidents which have been annually compiled since the former publication. For the illustrations now shown for the first time, I am indebted to Mr. Sydney Smith, Mr. Verney, and Mr. McNair, H.M. Inspectors of Factories, and to Mr. Counsell, Clerk at the Blackburn Office, who have furnished the necessary sketches; other drawings have been reproduced from the former Report. The guards illustrated are not mere suggestions, but are, in almost every instance, already in actual practical use.

I have the honour to be

Sir,

Your obedient Servant,

H. S. RICHMOND,

H.M. Superintending Inspector of Factories.

To H.M. Chief Inspector of Factories.

SAFE-GUARDS FOR THE PREVENTION OF ACCIDENTS IN THE MANUFACTURE OF COTTON.

In 1899 the Home Office issued a Blue Book entitled "The Prevention of Accidents from Machinery in the Manufacture of Cotton."* Since that date tabulated statistics have been annually kept of all accidents occurring in cotton factories in the North-Western Division, which embraces over 80 per cent. of the trade throughout the United Kingdom. These statistics not only amply justify the recommendations contained in that Report, but have also brought to light several additional points of danger, to the safe-guarding of which attention should be directed. In view of this, and also because in the interval a new Consolidating and Amending Act has come into operation, viz., the Factory Act of 1901, it has been considered desirable to bring the Report up to date and present in a more complete form the precautions which should be adopted for the better prevention of accidents to those engaged in the manufacture of cotton.

The Factory Act of 1901 makes certain additions to the requirements for safety, whilst the references in the former Report to the previous Acts are of course obsolete. It will be necessary, therefore, here to set forth the provisions as they now stand.

SAFETY.

Existing law as to fencing. Factory Act, 1901, Section 10.

"With respect to the fencing of machinery in a factory, the following provisions shall have effect:—

"(*a*) Every hoist or teagle and every fly-wheel directly connected with the steam or water or other mechanical power, whether in the engine-house or not, and every part of any water-wheel or engine worked by any such power must be securely fenced;

"(*b*.) Every wheel-race not otherwise secured must be securely fenced close to the edge of the wheel-race;

"(*c*.) All dangerous parts of the machinery and every part of the mill gearing must either be securely fenced or be in such position or of such construction as to be equally safe to every person employed or working in the factory as it would be if it were securely fenced; and

"(*d*.) All fencing must be constantly maintained in an efficient state while the parts required to be fenced are in motion or use, except where they are under repair or under examination in connection with repair, or are necessarily exposed for the purpose of cleaning or lubricating or for altering the gearing or arrangements of the parts of the machine."

In connection with the above provisions regarding the fencing of machinery, section 156 gives the following definitions:—

Definitions. Section 156.

"The expression 'machinery' includes any driving strap or band.

"The expression 'mill gearing' comprehends every shaft whether upright, oblique, or horizontal, and every wheel, drum, or pulley, or other appliance by which the motion of the first moving power is communicated to a manufacturing process.

"The expression 'process' includes the use of any locomotive."

As bearing upon sub-section (*a*) above, reference may be made to the case of *Johnson* v. *Richardson*, in the Queen's Bench Division, 4th June, 1896, in which it was held that the gear wheels of the governor of a steam engine must be fenced, notwithstanding the fact that the engine, as a whole, was fenced by a barrier running all round it.

The case of *Hindle* v. *Birtwistle* (1897), 1 Q. B. 192, affords an important decision as to the meaning to be put upon the term "dangerous machinery" in sub-section (*c*). It was there held that the enactment applies to all machinery from which, in the ordinary course of working it, danger may reasonably be anticipated, although such danger may arise by reason only of careless working or of external causes.

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* Report of two of H.M. Inspectors of Factories on the Prevention of Accidents from Machinery in the Manufacture of Cotton. [C. 9456.] Price 9*d*. Wyman & Sons, Fetter Lane, London, E.C.

It should be observed that the Factory Act of 1901 makes an important addition to the definition of "mill gearing" quoted above, in the words "or other applicance." By this addition all belts, &c., which communicate the first moving power from the shafting to the machines are rendered "mill gearing" and subject to the same provisions.

As to steam boilers, section 11.

Section 11 contains a new provision :—

"(1.) Every steam boiler used for generating steam in a factory or workshop or in any place to which any of the provisions of this Act apply must, whether separate or one of a range,

"(*a.*) have attached to it a proper safety-valve and a proper steam-gauge and water gauge to show the pressure of steam and the height of water in the boiler; and

"(*b.*) be examined thoroughly by a competent person at least once in every fourteen months.

"(2.) Every such boiler, safety-valve, steam-gauge, and water-gauge must be maintained in proper condition.

"(3.) A report of the result of every such examination in the prescribed form, containing the prescribed particulars, shall within fourteen days be entered into or attached to the general register of the factory or workshop, and the report shall be signed by the person making the examination, and, if that person is an inspector of a boiler-inspecting company or association, by the chief engineer of the company or association."

As to self-acting machines, section 12.

Section 12 provides regulations as to self-acting machines :—

"(1.) In a factory erected on or after the first day of January, one thousand eight hundred and ninety-six, the traversing carriage of any self-acting machine must not be allowed to run out within a distance of eighteen inches from any fixed structure not being part of the machine, if the space over which it runs out is a space over which any person is liable to pass, whether in the course of his employment or otherwise. Provided that nothing in this sub-section shall prevent any portion of the traversing carriage of any self-acting cotton-spinning or woollen-spinning machine being allowed to run out within a distance of twelve inches from any part of the headstock of another self-acting cotton-spinning or woollen spinning machine.

"(2.) A person employed in a factory must not be allowed to be in the space between the fixed and the traversing parts of a self-acting machine unless the machine is stopped with the traversing part on the outward run, but for the purpose of this provision the space in front of a self-acting machine shall not be included in the space aforesaid.

"(3.) A woman, young person, or child must not be allowed to work between the fixed and traversing part of any self-acting machine while the machine is in motion by the action of steam, water, or other mechanical power.

"(4.) A factory in which a traversing carriage is allowed to run out in contravention of this section shall be deemed not to be kept in conformity with this Act, and any person allowed to be in the space aforesaid or to work in contravention of this section shall be deemed to be employed contrary to the provisions of this Act."

As to cleaning machinery in motion, section 13.

Section 13 imposes certain restrictions on cleaning when machinery is in motion :—

"(1.) A child must not be allowed to clean in any factory—

"(*a.*) any part of any machinery, or

"(*b.*) any place under any machinery other than overhead mill gearing,

while the machinery is in motion by the aid of steam, water, or other mechanical power.

"(2.) A young person must not be allowed to clean any dangerous part of the machinery in a factory while the machinery is in motion by the aid of steam, water, or other mechanical power; and for this purpose such parts of the machinery shall, unless the contrary is proved, be presumed to be dangerous as are so notified by an inspector to the occupier of the factory.

"(3.) A woman or young person must not be allowed to clean such part of the machinery in a factory as is mill gearing while the machinery is in motion for the purpose of propelling any part of the manufacturing machinery.

"(4.) A woman, young person, or child allowed to clean in contravention of this section shall be deemed to be employed contrary to the provisions of this Act."

As regards the restriction on cleaning when machinery is in motion it was held in the case of *Pearson* v. *Belgian Mills Co.* that it is not limited to cleaning moving parts of a machine, but that if the machinery as a whole is in

motion it is not permissible to clean any part of it, even though the actual part so cleaned is at rest.

As to fire escapes, sections 14 and 15.

Sections 14 and 15 make provision for factories and workshops being supplied with sufficient means of escape in case of fire.

As to doors, section 16.

Section 16 further provides that whilst any person is within a factory or workshop for the purpose of employment or meals, the doors of the factory or workshop and of any room in which such person is must not be locked or bolted or fastened in such manner that they cannot be easily and immediately opened from the inside ; and an additional provision is also made that in every factory or workshop, the construction of which was not commenced before the 1st day of January, 1896, the doors of each room in which more than 10 persons are employed shall, except in the case of sliding doors, be constructed so as to open outwards.

As to dangerous ways, &c., sections 17 and 18.

Moreover, the Factory Act of 1901 gives further powers to Inspectors to deal with "dangerous ways, works, machinery, or plant (including a steam boiler used for generating purposes)" and also with "unhealthy or dangerous factories or workshops" by applying to a Court of Summary Jurisdiction for an Order prohibiting their use until steps are taken to remedy the danger.

As to regulations for dangerous machinery, &c., section 79.

Whilst, lastly, section 79 contains the very important provision that where the Secretary of State is satisfied that any manufacture, machinery, plant, process, or description of manual labour is dangerous or injurious to health, he may certify that manufacture, machinery, &c., to be dangerous, and thereupon may make such regulations as appear to him to be reasonally practicable and to meet the necessity of the case.

The above embrace all the provisions enacted by the Factory Act, 1901, under the heading of safety, and are of course equally applicable to textile and non-textile works, as also are the general recommendations which are contained in the above-mentioned Blue Book, and which it will be well to recapitulate here before passing to the main object of these pages, namely, the consideration of safety as specially connected with machinery used in the manufacture of cotton.

General Recommendations.

(1.) That no projecting set screws, &c., be allowed on anything that revolves. This applies not only to machines themselves, but also to the couplings and loose collars of shafting.

(2.) That all toothed wheels be effectually covered so that there shall be no danger between the guard and the wheels.

(3.) That all machines be provided with loose pulleys and strap forks.

(4.) That plate wheels be substituted wherever possible for exposed arm wheels running at high speed ; where this is impracticable the wheels should be fenced.

(5.) That exposed shaft ends be securely covered.

(6.) That all persons oiling mill gearing, or otherwise employed near it be supplied with and shall wear close-fitting jerseys or boiler suits.

The above recommendations must be taken as applying to all machinery whether specifically mentioned below or not. There are, of course, a number of machines used in connection with cotton mills similar to those found in fitting shops, saw-mills, dye-houses, &c., with which it is not here intended to deal, but to which such requirements equally apply. Neither is it desirable here to enter at any length into the question of compliance with the definite enactments of the Act as to secure fencing of engines, &c., moved by mechanical power, so much depending upon their construction and position ; whilst as regards hoists, a Special Report* was issued by the Home Office in 1904 on the

* Report on the Construction, Arrangement, and Fencing of Hoists and Teagles ; by Mr. W. Sydney Smith, H.M. Inspector of Factories. [Cd. 2051.] Price 5*s.* 6*d.* Wyman and Sons, Fetter Lane, London, E.C.

Hoists.

means to be taken for safe-guarding them. Hoists, however, form so essential a part of the equipment of cotton mills, and accidents therefrom are annually so numerous and of such a serious nature, that it may be advantageous to call attention to the classification of hoist accidents given in the above-mentioned Report:—

(1.) Falls down hoist wells.

(2.) Crushes between ascending or descending cages, and

(*a.*) Doors or other fences for hoist openings.

(*b.*) Projections in hoist wells.

(*c.*) Bottoms of hoist wells.

(*d.*) Beams or mechanism at tops of hoist wells.

(3.) Breaking of suspending ropes.

(4.) Falling substances striking persons travelling in cage.

Indiscriminate use of hoists should be forbidden, and wherever possible a hoist attendant of mature age should be employed, whose sole duty should be to attend to the hoist; otherwise the doors should be locked and the keys placed in charge of a responsible person.

Doors or gates should be not less than 6 feet in height, and should close automatically as the cage leaves each floor. All projections in hoist wells, including door lintels, should be bevelled by sloping boards, and the sides of all hoist wells be made smooth.

A clearance of at least 3 feet should be left between the top and bottom of the hoist well and the cage at the points of its highest and lowest travel.

Hoist cages should be suspended by not less than two independent ropes or chains, which should be periodically examined.

The tops of all hoist cages should be efficiently covered.

Suitable locking grips should be provided for all hand starting-ropes.

In the following pages it is intended to deal with the more indefinite requirement of the Act that "all dangerous parts of the machinery must be securely fenced," with special reference to its application to machines in general use in spinning and weaving of cotton, from the bale to the finished cloth.

Cotton Spinning.

Whilst broadly speaking, the manufacture of cotton may be divided into two main branches, viz., spinning and weaving, the machinery connected with the former may be classified under three principal departments—blowing room, card room, and spinning room.

Blowing room.

Blowing-room machinery has of recent years, and since the publication of the 1899 Report, undergone considerable modification and improvements, which tend also towards safety. The machines of the old bale breaker type with their dangerous exposed feed rollers and cog-wheels, for which improved guards were specially recommended, have been superseded and the machines generally coupled up together, less handling of the cotton being thus required.

The machines commonly in use in the blowing room are bale breakers, hopper feeders, combined openers and lap machines, scutchers, and, in some cases, roving waste openers. Whilst the above-mentioned general recommendations should be carefully observed with regard to all these machines, special attention should be directed to the numerous serious accidents which occur through the "beaters" of openers and lap machines, of scutchers, and of roving waste openers. These and other similar machines should be fitted with automatic locking arrangements for the covers, so that they cannot be opened whilst the machine is in motion, nor the machine be re-started till the covers are closed. As in the case of card cylinders, however, the beaters will

continue to run for a time after the belt has been placed on the loose pulley, and therefore those arrangements which prevent the covers from being opened until the beater shaft is completely at a standstill are preferable (Plates 1 and 2). Such arrangements have for many years been absolutely compulsory in Russia and elsewhere. Complete guards should also be supplied for the cage wheels and calender wheels of openers, scutchers, &c. (Plates 3 and 4), whilst the low side wheels of scutchers should be fenced.

Card room.

In the card room the machines in ordinary use are carding engines, drawing frames, and speed frames (slubbing, intermediate, and roving), with the addition in the case of fine spinning of lap, combing, and jack frames.

Carding engines.

Since the publication of the 1899 Report considerable improvement has also been effected in new carding engines, in accordance with the recommendations contained therein. The necessity of more effectual guards was then pointed out for the toothed wheels at either end of the side shaft (Plate 5), for doffer and barrow wheels (Plate 6), and for the train of wheels driving the feed rollers, whilst the provision of strap forks was strongly advocated. In most instances for new machines good guards are now provided for all the wheels named, except perhaps for the train of wheels, which still need attention by some makers, whilst in a number of cases strap forks are now in use. In addition to these points, the annual statistics have brought to light the need of additional safe-guards for "lickers-in" and cylinders. The covers of the former should in the case of all flat cards be screwed down so that they cannot readily be lifted whilst the machines are in motion; and the very serious nature of accidents occurring through the large cylinder covers being carelessly left open, or falling open, has led to the invention of simple but effectual means to obviate this class of accidents, which should certainly be insisted upon. All makers of cotton machinery are now prepared to supply such safe-guards, which are of various types. Probably the simplest and best are those worked in combination with the strap fork, whereby the driving belt must be moved on to the loose pulley before the cylinder cover can be opened, and similarly, when the cover is open, it must be closed before the belt can be placed on to the fast pulley and the carding engine be re-started. Two very simple arrangements of this type, designed by practical operatives at their respective mills, have now for some time been in actual operation, and have proved eminently satisfactory. Messrs. Witham & Lord's arrangement, applicable to carding engines on which the cylinder cover is hinged at the bottom, is illustrated by Plate 7, Fig. 1, and Plate 8, whilst Plate 7, Fig. 2, shows a modification of the same in cases where the cylinder cover is hinged at the top. Messrs. R. Thompson & Son's arrangement is illustrated by Plate 9. Other contrivances for automatically closing the cylinder covers, in the absence of strap forks, are actuated either by a spiral spring, as in Fairclough's safety appliance, or by means of a weight, as in the arrangement of Messrs. Lees & Smalley (Plate 10). Either type illustrated effectually prevents the cylinder cover from being inadvertently left open, or from falling open as sometimes occurs in the case of carding engines with covers hinged at the bottom; but those connected with the strap fork have the additional advantage of preventing the opening of the cover by hand till the belt has been moved from the fast to loose pulley. In each case, nevertheless, further care on the part of the stripper is requisite owing to the fact that the cylinder will continue to run from its own momentum for some little time after the belt has been moved on to the loose pulley. It is however mechanically feasible to arrange so that the cover cannot be opened till the cylinder has ceased to run. Such latter arrangements have only recently been practically applied in a few instances, but the advantage attached to them is undoubted. Plate 11 illustrates such an arrangement, introduced by Messrs. Catlow, Marsden, and Dunn, the two last named being respectively mechanic and carder at Messrs. Catlow's mill, Padiham, and is thus described :—

> "The object of this invention is to prevent the cover being opened until the cylinder itself is stationary, and to prevent the machine being re-started until the cover is again closed and fastened, the cylinder being consequently always guarded when in motion. The sneck or fastener for the cover is mounted on the stud or shaft which carries the strap fork, and is provided with a finger which lies over a multiple tappet or star wheel on the shaft of the cylinder. The boss of the strap fork and the

sneck or fastener are made clutch-like, or provided with recesses and projections, so as to engage with one another: thus the fastener is locked and the cover secured when the machine, or the cylinder, is in motion. When the belt is transferred to the loose pulley the clutch portion disengages and the fastener is free, but whilst the cylinder continues to move and the star wheel to rotate, the projections on the latter acting on the finger of the fastener prevents the latter being raised to open the cover. When the cylinder stops the finger can be depressed or lowered into one or other of the recesses of the star wheel, and the sneck end can be sufficiently raised to unfasten the door. Owing to the clutch or recesses and projections on the bosses of the fastener and strap fork, the belt cannot be again transferred to the fast pulley, nor the cylinder set in motion, until the fastener is placed in such a position as to engage with and fasten the cover, which must be previously closed to admit of this."

I have also received from Mr. Verney, H.M. Inspector of Factories, a sketch of a method suggested by him to accomplish the same object in the following manner (Plate 12) :—

"A thin ring A having a number of apertures B is screwed to the back of the fast pulley; two arms C and D are carried by a pivot E, which turns in two brackets F in such a way that when the end of the arm C is within one of the apertures on the ring A, which cannot happen unless the cylinder is stopped, the end G of the arm D has moved away from the stripping door H, allowing the latter to be opened. As soon as the door has been opened a spring J returns the arms to their former position; G is now under the door and the end of C is clear of the ring; the cylinder can now be turned for stripping. This done, the brush is taken out and the door closes by means of a spring K, or a balance weight, whichever may be most conveniently fitted to any particular carding engine. The end G offers no obstacle to the closing door, as it is hinged with a sort of rule joint provided with a spring as shown in the smaller figure; the hinged end may be deflected by the closing door, but not by attempting to open the door."

In addition to the serious accidents frequently caused by the large stripping cylinders, statistics show that many occur through the doffer cylinders also. The covers for these, as made by most makers, only protect a portion of the cylinders, and as these revolve upwards towards the covers which are fixed, danger is obvious. Some cards of recent date are provided with covers extending over the whole of the doffer cylinders, whilst if the lower portion of the covers were hinged, accidents would be avoided, as the lifting of the hinged portion would release the hand if caught.

One of the most serious dangers attendant on the working of carding engines hitherto has been the system in vogue for grinding operations. For the purpose of grinding it is necessary for the large cylinder to be reversed, and to accomplish this it has been the universal practice to remove the driving belt from the pulleys both on the machine itself and on the shafting, and then after crossing the belt to replace it. This operation which, being performed by hand, has been the frequent cause of very serious accidents, has always been urged as the chief impediment in the way of the adoption of strap forks. It would now appear that this system is entirely unnecessary, as the reversing of the cylinder can readily be accomplished otherwise without touching the belt, and therefore without the attendant risk. The method alluded to would appear to be an old patent, allowed to drop, which has recently been improved and re-introduced. Each grinding apparatus is supplied with a three-grooved pulley, the grooves being of different diameters; this pulley is placed on the end of the doffer shaft and connected by means of a $\frac{5}{8}$-inch rope crossed with the groove on the loose pulley of the carding engine (Plate 13). By this means the large cylinder is capable of being reversed for grinding operations, whilst the requisite speed for slow or fast grinding can simply be arranged by means of the diameter of the groove used.

Drawing frames.

Dealing with drawing frames, loose pulleys and strap forks should be required in all cases, so that the undershaft may be stopped for the purposes of cleaning underneath the frames. Their absence has been a conspicuous fault in most of the old frames. Fenders should be provided for the driving pulleys, and automatic locking motions to prevent the covers for the draft change wheels and calender wheels being opened whilst the frames are in motion.

Speed frames.

Slubbing, intermediate, roving, and jack frames are practically similar in mechanical detail, and the safe-guards recommended in the 1899 Report are now almost universally provided by makers of machinery. The points mentioned were the provision of guards for the draft change wheels, which should

be fitted with automatic locking arrangements ; of metal instead of wooden covers for the bottom spindle shaft and wheels ; of automatic locking doors for the back gearing (Plate 14) ; of balance weights cast with eyelets forming part of the weights themselves ; and of guards under the bull muzzle for the wheels driving the bobbin shaft. Statistics of accidents have, in addition, called attention to the danger to fingers arising from the lifter rack and pinion wheels, which should be fenced in all new frames (Plate 15). A cover to the three screw heads which are necessary to fasten the top cone drum to the shaft should also be provided.

Lap and combing machines.

Lap and combing machines usually present no special features beyond the general recommendations as to cog-wheels and set screws. The most noticeable accidents occur through the lap rollers, but these are not so much attributable to want of guards as to carelessness on the part of the tenters themselves, more especially in the case of sliver lap and similar machines, when placing a fresh spindle in position, through re-starting the machine before their fingers are out of the way.

Spinning room.

The process of spinning is now practically carried out by two classes of machines—self-acting mules and ring spinning frames.

Self-acting mules.

Statistics show that by far the largest number of accidents occur in the mule room, and these machines consequently require special attention as to requisite safe-guards which were fully detailed in the 1899 Report, since which constant pressure put upon makers of machinery and occupiers of factories by H.M. Inspectors has caused very great improvements with satisfactory results. In proof of this it may be stated that machinery accidents in mule rooms which in 1900 amounted to 810 were consistently reduced year by year till there were only 587 in 1904, and although the number rose somewhat in 1905, that was owing to the very large increase in the number of spindles during that year. This reduction is all the more satisfactory when it is found that it has chiefly occurred in accidents arising from those parts for which special guards were advocated. Administrative action, however, having failed to produce uniformity of fencing in all districts, the Secretary of State, taking advantage of the powers bestowed upon him under section 79 of the Factory Act, 1901, has declared self-acting mules to be machinery dangerous to life and limb, and has made such Regulations as appeared to him to be reasonably practicable and to meet the necessity of the case. These Regulations, which came into force on 1st January, 1906, and apply to all factories or parts thereof in which the process of spinning by means of self-acting mules is carried on, are as follows :—

"Whereas certain machinery used in the process of spinning in textile factories, and known as self-acting mules, has been certified, in pursuance of section 79 of the Factory and Workshop Act, 1901, to be dangerous to life and limb.

"I hereby, in pursuance of the powers conferred on me by that Act, make the following Regulations, and direct that they shall apply to all factories or parts thereof in which the process of spinning by means of self-acting mules is carried on.

Minder.

"1. In these Regulations the term 'Minder' means the person in charge of a self-acting mule for the time being.

Duties of owners, occupiers, and employees.

"2. Save as hereinafter provided it shall be the duty of the occupier of a factory to observe Part I. of these Regulations; provided that it shall be the duty of the owner (whether or not he is one of the occupiers) of a tenement factory to observe Part I. of these Regulations, except so far as relates to such parts of the machinery as are supplied by the occupier.

"It shall be the duty of the persons employed to observe Part II. of these Regulations, but it shall be the duty of the occupier, for the purpose of enforcing their observance, to keep a copy of the Regulations in legible characters affixed in every mule room, in a conspicuous position where they may be conveniently read.

"PART I.

"*Duties of Occupiers.*

Fencing.

"3. After January 1st, 1906, the following parts of every self-acting mule shall be securely fenced as far as is reasonably practicable, unless it can be shown that by their position or construction they are equally safe to every person employed as they would be if securely fenced.

"(*a.*) Back shaft scrolls and carrier pulleys and draw band pulleys

"(*b.*) Front and back carriage wheels.

"(*c.*) Faller-stops.

"(*d.*) Quadrant pinions.

"(*e.*) Back of head-stocks, including rim-pulleys and taking-in scrolls.

"(*f.*) Rim band tightening pulleys, other than plate wheels, connected with a self-acting mule erected after January 1st, 1906.

"PART II.

"*Duties of persons employed.*

"4. It shall be the duty of the minder of every self-acting mule to take all reasonable care to ensure :—

Cleaning, &c.

"(*a.*) That no child cleans any part or under any part thereof whilst the mule is in motion by the aid of mechanical power.

"(*b.*) That no woman, young person, or child works between the fixed and traversing parts thereof whilst the mule is in motion by the aid of mechanical power.

"(*c.*) That no person is in the space between the fixed and traversing parts thereof unless the mule is stopped on the outward run.

Starting mules.

"5. No self-acting mule shall be started or re-started except by the minder or at his express order, nor until he has ascertained that no person is in the space between the fixed and traversing parts thereof."

Seeing that in future efficient guards are compulsory for all parts of self-acting mules named in Part I. of these Regulations, it will be well here to give illustrations of some of the latest approved types in use.

(*a.*) Plates 16, 17, and 18 show guards for the back shaft scrolls and carrier pulleys, and Plate 19 for the draw bands and pulleys.

(*b.*) Guards for carriage wheels are of two types, termed "riding" and "sliding" guards. Plate 20 and Plates 21 and 22 illustrate these types respectively. It will be noticed that whilst the former require fixing to a bracket, the latter need no fixing.

(*c.*) Plate 23 shows the most recent and effective guard for faller stops.

(*d.*) Guards for quadrant pinions vary according to the pattern of the mule. Plate 24 illustrates an effectual method of fencing where the quadrant arm is in a line with the pinions. The guard is shown in position when the quadrant arm is extended, and thrown back by the arm when close up to the pinions. Other types of guards are shown in Plate 25.

(*e.*) Plate 26 shows a complete guard for the back of the headstock, including both rim pulley and taking-in scrolls.

(*f.*) Plate 27 illustrates a method of fencing the rim-band pulley on the tail-piece of the headstock when it is not a plate wheel.

Twiners.

Self-acting twiner mules present very similar characteristics to the above and should be fenced in like manner.

Ring frames.

Ring frames are now fairly well fenced by most makers. The bulk of accidents occur through cog-wheels and tin rollers. The former should be carefully covered with automatic locking arrangements for the back roller and draft wheels, whilst as regards the latter, complete guards are requisite for the off end of the frame, and a guard rod is advisable running the whole length of the frame between the bottom rail and the floor, several serious accidents having occurred through workers being caught between the tin rollers.

The remarks on ring frames apply equally to throstle frames, and ring and throstle doubling frames, which are of somewhat similar make.

Weaving.

Weft yarn, whether from the mule or ring spinning frame, is in the case of plain goods ready for the manufacture of cloth, but warp yarn must pass through at least three processes, viz., winding, warping, and sizing before it is ready for the loom. The machinery chiefly in use for these processes are winding frames, beam warping frames, and tape sizing machines or slashers, whilst in the case of coloured goods, reels also are necessary to convert the yarn into hanks before being dyed. The machines named present no very special features of danger peculiar to themselves, but have been chiefly noticeable for projecting set screws and insufficiently-guarded cog-wheels, more especially in the case of slashers. The first should be countersunk and the latter covered, so as to leave no danger between the guards and the cogs.

Looms.

Next to self-acting mules, looms have always been productive of the largest number of accidents among cotton machinery. Probably less has been done by makers during recent years to improve the construction of looms with a view to safety than in the case of any other machines, and statistics continue to show the same causes of accidents from year to year. Reference to the tables of accidents set forth from time to time in the annual Reports calls attention to the following points of danger :—

(1.) Flying shuttles.
(2.) Driving wheels (crank, tappet, and balance wheels).
(3.) Picking sticks, pins, &c.
(4.) Hammers.
(5.) Duckbills.
(6.) Cog-wheels.
(7.) Treadles.
(8.) Projecting set screws.

(1) Shuttle guards.

Although shuttle guards are now in general use, they are frequently adjusted in an inefficient manner. They are often too short, or are placed either too high on or too far from the slay cap. The most effective guards take the form of a steel wire rod of sufficient thickness and as long as is practicable between the weft fork on the one side and the shuttle box on the other ; in no case should the unguarded space between the shuttle box and the guard exceed half the length of the shuttle itself, but should preferably be slightly less. Guards should be so fixed as to leave mere finger-room between the temple and guard, whilst the distance from guard to slay-cap should be $\frac{1}{4}$ inch less than the greatest width of the shuttle. Rod guards are either rigid or semi-automatic, the former possessing the advantage of always being in their place, whilst the latter at times get out of order and do not return to their proper position when the loom is re-started. Even when fitted as suggested, however, a single rod scarcely covers the whole space from which a shuttle may fly, and in consequence some looms have been fitted recently with a double rod, one of which, or possibly both, might be semi-automatic so as to interfere as little as possible with the fingers of the weavers. The causes of shuttles flying are various, but the object of the guard is to cause them to be deflected and thus be less dangerous to the weavers.

(2) Driving wheels.

Many accidents from driving wheels would be avoided by the substitution of plated balance-wheels in the place of armed wheels, which would act as guards to the toothed crank and tappet wheels, whilst a small V-shaped guard might be provided for the intake of the latter wheels where additional precaution is desired. The balance-wheel should also be at least one inch clear from the crank-wheel.

(3) Picking sticks, &c.

Many accidents from picking sticks and pins might be avoided by the adoption of double picker bands, or even by the substitution of round-headed screws or pins.

(4) Hammers. Accidents from hammers can be obviated by either shortening their heads or, as preferred by some makers, by lengthening them so as to be always over the breast-plate. In old looms, moreover, the hammers can be adjusted high enough to leave finger-room between them and the breast-plate.

(5) Duckbills. Effective guards (Plate 28) are now available for duckbills, and these should be insisted upon in the case of all new loose reed looms, as accidents at these points are serious.

(6) Treadles. Attention was called in the Report published in 1899 to accidents from treadles, and the recommendation was made that where the treadles work in a grate, the latter should be made of sufficient depth to leave one inch of space at the top and bottom when the treadles are extended. Such accidents, however, can only occur where cleaning is carried on under the loom whilst in motion.

(7) Set screws. Projecting set screws both on the collars of the loose pulleys and underneath the looms on the crank and tappet shafts, &c., should invariably be countersunk, and numerous accidents be annually avoided thereby.

In the case of Jacquard looms, the main driving shaft generally runs close to the overhead cards, which have frequently to be adjusted; where this is the case, the shaft should be covered the full width of the cards, and, on the approach side, some distance beyond.

Cleaning looms in motion. A very large number of loom accidents occur not so much from want of guards as from the dangerous and reprehensible practice of cleaning them whilst in motion. This practice is fostered by the system, which prevails in almost every weaving shed, of each weaver being responsible for cleaning his or her looms. As all weavers and most overlookers are on piece work, and their weekly wages depend upon the output of the looms, the latter are stopped as little as possible. The engines run during the whole of the legal periods of employment throughout the week, except from 11.30 a.m. to noon on Saturdays, which half hour was intended by the Act for cleaning, &c.; but even that has to some extent been neutralised by a claim put forward on behalf of the weavers that the mill doors should be opened and the weavers allowed to depart at 11.30 a.m. or soon after. In some few sheds the American system has been adopted, with beneficial results both to employers and employed. Under this system special male adult cleaners, &c., are employed, and the weavers are relieved of all duties save attention to actual weaving; sweeping, cleaning, oiling, carrying of weft and cloth, and cloth picking are all done for them. Two years' trial of this system at a large shed at Burnley have shown the following results:—The average output of each loom has increased by 9*d.* per week; of this 3½*d.* per loom is deducted by the employers to meet the payment of the cleaners, &c., whilst the weaver receives the other 5½*d.* A weaver therefore attending to four looms is relieved from considerable laborious and dirty work, and yet earns 1*s.* 10*d.* per week more than previously, whilst the employer is relieved of responsibility for illegal cleaning, &c. during meal times by protected hands, and for numerous accidents through cleaning machinery in motion: he also obtains a larger output of cloth and in a cleanlier state. Moreover, weavers in such sheds present a much tidier appearance, and affirm that they are much less tired and more ready for their home duties at the end of the day than formerly. Hitherto this system has not received much favour from the Weavers' Associations, but the certain consequent reduction in the number of accidents to their members should lead to its general adoption in the near future. A modified form of the above system has recently been on trial at some sheds, whereby the weavers are relieved of cleaning and cloth carrying only at a charge of 2*d.* per loom per week.

In conclusion, attention is directed to the following Tables (*vide* Appendix) showing the number and principal causes of cotton machinery accidents during the years 1900 to 1905 inclusive. It will be noticed that the total number of accidents reached its lowest point in 1904, and showed a reduction of 482 as compared with the highest point in 1901, the number for the respective years being 1,960 as against 2,442. It is true that the number rose again in 1905 to

2,350, but this beyond doubt was due to the very large increase in the number of cotton mills and the consequent additional machinery in use. This increase is still continuing, and it appears that in Lancashire, in spinning alone, 65 new mills had either been opened or were in course of erection at the close of 1905, with a total addition of 5,740,356 spindles; whilst it is reported from the Blackburn cotton cloth factories district that there was an addition of 16,000 looms during the same year. This reduction in the number of accidents from 1900 to 1904 is all the more gratifying when it is seen that it chiefly occurred in connection with those parts of the various machines for which special guards were advocated in the 1899 Report, and which have been since continually pressed for by H.M. Inspectors. The most striking example of this is the case of self-acting mules mentioned above, accidents from which were reduced year by year from 810 in 1900 to 587 in 1904.

H. S. RICHMOND.

18*th June*, 1906.

APPENDIX.

TABLES SHOWING THE NUMBER AND PRINCIPAL CAUSES OF COTTON MACHINERY ACCIDENTS IN THE NORTH-WESTERN DIVISION DURING THE YEARS 1900 TO 1905.

Table 1.—All machinery accidents in cotton mills.
„ 2.—Accidents in connection with self-acting mules.
„ 3.— „ „ „ „ looms.
„ 4.— „ „ „ „ carding engines.
„ 5.— „ „ „ „ speed frames.
„ 6.— „ „ „ „ scutchers.
„ 7.— „ „ „ „ ring and throstle frames.
„ 8.— „ „ „ „ drawing frames.
„ 9.— „ „ „ „ winding frames and reels.
„ 10.— „ „ „ „ combers and lap doublers.
„ 11.— „ „ „ „ plaiting machines.
„ 12.—Cotton machinery accidents resulting fatally.

MACHINERY ACCIDENTS IN COTTON MILLS.

TABLE 1.

Class of Machinery.	Machines.	Number of accidents.					
		1900.	1901.	1902.	1903.	1904.	1905.
Prime movers	Engines, &c.	48	40	42	30	26	17
Mill gearing	Driving shafts and belts	22	20	36	18	21	40
Lifting tackle	Hoists, cranes, and teagles	79	67	114	95	65	88
Fitting shops, &c. ...	Lathes, circular saws, &c.	35	23	21	18	16	19
Fans	Fans	—*	11	8	11	2	6
Grindstones	Grindstones and emery wheels, &c. ...	—*	16	7	13	8	5
Blowing room	Bale and waste breakers	20	22	19	26	23	20
„ „	Cotton feeders and openers	34	41	26	21	28	33
„ „	Scutchers	72	83	63	54	57	47
Card room	Carding engines	242	243	230	197	191	231
„ „	Drawing frames	47	68	68	57	44	74
„ „	Speed frames	270	287	268	233	234	296
„ „	Combers, lap frames, and Derby doublers	35	31	45	57	52	54
Spinning room	Self-acting mules	810	787	690	636	587	673
„ „	Ring and throstle frames	78	74	81	71	86	85
Doubling machinery ...	Doubling frames and twiners	21	16	26	15	11	12
Winding and reeling ...	Winding frames and reels	45	33	44	43	43	63
Weaving machinery ...	Slashers, warping and sizing machines	34	24	32	19	19	33
„ „ ...	Looms	457	505	509	436	400	511
Thread machinery ...	Polishing, balling, &c.	16	9	9	11	6	—
Warehouse machinery ...	Plaiting machines	12	25	37	23	25	22
Miscellaneous	Various	12	17	19	14	16	21
	Totals	2,389	2,442	2,394	2,098	1,960	2,350

* Included in miscellaneous accidents in 1900.

MACHINERY ACCIDENTS IN COTTON MILLS—*continued.*

TABLE 2.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Self-acting Mules—						
Between fixed and traversing parts	102	100	120	84	102	93
Between carriage and pillar or wall	56	71	48	53	24	24
Between carriage of one mule and opposite mule ...					23	27
Scroll bands, draw-bands, and pulleys	118	103	87	69	61	66
Carriage wheels and slips	119	91	58	53	32	42
Faller stops	36	61	28	26	20	12
Rim pulleys	78	62	54	41	17	16
Headstocks					24	26
Cog-wheels	64	52	23	27	19	19
Quadrant pinions...	20	27	27	9	13	9
Driving straps and pulleys	48	36	43	57	47	36
Projecting set-screws	10	14	10	12	18	10
Miscellaneous	159	170	192	205	187	296
Totals	810	787	690	636	587	676

TABLE 3.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Looms—						
Flying shuttles	78	96	63	70	74	102
Driving wheels	52	29	49	37	36	29
Picking sticks, &c.	45	50	52	63	40	49
Hammers	35	39	21	19	22	22
Duckbills	26	21	19	16	22	27
Cog-wheels	33	38	36	24	35	32
Treadles	14	16	18	12	10	29
Crank and tappet shafts...	10	29	8	20	9	9
Driving straps and pulleys	11	14	21	20	15	12
Projecting set-screws	9	10	12	14	15	18
Miscellaneous	144	163	210	141	122	182
Totals	457	505	509	436	400	511

MACHINERY ACCIDENTS IN COTTON MILLS—*continued.*

TABLE 4.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Carding Engines—						
Driving straps and pulleys	70	36	31	34	29	35
Other straps and pulleys		15	42	25	39	40
Takers-in	41	53	37	22	10	18
Cylinders	29	29	24	28	24	34
Carrier wheels	25	20	12	9	7	6
Coiler wheels	12	12	10	12	14	10
Draw-box wheels	2	3	6	3	6	4
Side-shaft bevel wheels	9	7	7	4	4	2
Doffer wheels	14	25	26	18	13	13
Calender wheels	—	9	6	4	5	4
Projecting set-screws	3	4	7	4	3	4
Miscellaneous	37	30	22	34	27	61
Totals	242	243	230	197	191	231

TABLE 5.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Speed Frames—						
Draft change wheels	48	30	24	16	28	21
Lifter rack and pinion	35	36	33	31	28	29
Projecting set-screws	25	21	14	13	16	29
Spindle shaft wheels	23	18	29	21	13	25
Bobbin shaft wheels	17	22	31	25	23	30
Straps and pulleys	22	31	29	27	21	25
Balance weights falling	21	21	10	7	12	18
Twist and carrier wheels	17	20	11	24	19	13
Jack-box wheels	14	6	7	6	4	7
Other cog-wheels	—	33	25	22	16	37
Miscellaneous	48	49	55	41	54	62
Totals	270	287	268	233	234	296

MACHINERY ACCIDENTS IN COTTON MILLS—*continued.*

TABLE 6.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Scutchers—						
Lap rollers, &c.	22	20	27	17	20	13
Beaters	15	19	7	15	15	16
Straps and pulleys	10	7	10	6	9	6
Cage wheels	4	6	4	6	4	2
Cog-wheels	8	8	2	1	2	—
Projecting set-screws	—	—	1	—	—	—
Miscellaneous	13	23	12	9	7	10
Totals	72	83	63	54	57	47

TABLE 7.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Ring and Throstle Frames—						
Cog-wheels	30	36	43	35	38	31
Straps and pulleys	14	15	7	16	10	15
Tin rollers...	9	10	11	8	25	23
Projecting set-screws	1	1	—	—	—	—
Miscellaneous	24	12	20	12	13	16
Totals	78	74	81	71	86	85

TABLE 8.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Drawing Frames—						
Under shaft	6	2	—	1	—	—
Cog-wheels	15	34	48	27	13	11
Projecting set-screws	8	4	8	5	2	10
Straps and pulleys	8	8	5	8	9	16
Calender rollers and wheels	—	6	—	10	15	24
Miscellaneous	10	14	7	6	5	13
Totals	47	68	68	57	44	74

MACHINERY ACCIDENTS IN COTTON MILLS—*continued.*

TABLE 9.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Winding Frames and Reels—						
Cog-wheels	16	12	14	16	14	24
Projecting set-screws	—	4	1	1	—	—
Driving straps	—	—	—	—	5	8
Miscellaneous	19	17	29	26	24	31
Totals	35	33	44	43	43	63

TABLE 10.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Combers and Lap Doublers—						
Cylinder rollers	21	9	18	30	28	20
Cog-wheels	6	12	9	8	6	9
Knives	3	2	3	4	6	—
Projecting set-screws	2	—	1	5	1	—
Miscellaneous	3	8	14	10	11	25
Totals	35	31	45	57	52	54

TABLE 11.

Parts of Machines.	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Plaiting Machines—						
Blades of knives	5	13	17	13	12	9
Cranks, &c.	4	5	5	—	6	4
Cog-wheels	2	6	9	2	2	5
Miscellaneous	1	1	6	8	5	4
Totals	12	25	37	23	25	22

MACHINERY ACCIDENTS RESULTING FATALLY.

TABLE 12.

	Number of Accidents.					
	1900.	1901.	1902.	1903.	1904.	1905.
Boilers	—	—	1	—	—	—
Engines, &c.	1	4	3	1	2	1
Mill gearing	3	4	1	3	3	5
Hoists	7	4	8	4	3	6
Self-acting mules	4	5	1	3	4	5
Looms...	—	—	—	2	—	—
Carding engines	1	1	1	—	—	4
Scutchers	—	—	—	—	1	1
Ring frames	1	1	—	—	1	1
Lathe	—	—	—	1	—	—
Totals	17	19	15	14	14	23

INDEX OF PLATES.

Plate.	Figure.	Subject.
1	1 and 2	Locking mechanism for beater covers and glass doors of scutchers.
2	—	Messrs. Witham & Lord's arrangement for locking the beater covers of scutchers till the beater shaft is completely at a standstill.
3	1 and 2	Incomplete and complete guards for spur wheels of scutchers, &c.
4	—	Complete guards for calender gearing and armed cage wheels of exhaust openers.
5	—	Guards for bevel wheels at each end of the side shaft of carding engines.
6	1 and 2	Incomplete and complete guards for doffer and barrow wheels of carding engines.
7	1 and 2	Messrs. Witham & Lord's locking motions for cylinder covers of carding engines.
8	—	
9	1 and 2	Messrs. R. Thompson & Son's locking motion for cylinder covers of carding engines.
10	1 and 2	Messrs. Lees & Smalley's arrangement for closing stripping doors of carding engines.
11	—	Messrs. Catlow, Marsden, & Dunn's locking motion for prevention of the opening of cylinder covers of carding engines till the cylinder has ceased to run.
12	1, 2, and 3	Mr. Verney's suggestion for accomplishing the same object.
13	1, 2, and 3	Method of reversing motion of cylinders of carding engines for purposes of grinding.
14	1 and 2	Automatic locking doors for back gearing of speed frames.
15	1 and 2	Guard for lifter rack and pinion of speed frames.
16	1 and 2	Guards for middle back shaft scrolls and carrier pulleys of self-acting mules.
17	1 and 2	
18	—	Guard for scroll on end of back shaft of self-acting mules.
19	1, 2, and 3	Guards for drawing out bands and pulleys of self-acting mules
20	1 and 2	Riding guard for carriage wheels of self-acting mules.
21	1, 2, and 3	Sliding guards for carriage wheels of self-acting mules.
22		
23	1 and 2	Improved guard for faller stops of self-acting mules.
24	1 and 2	Guards for quadrant pinions of self-acting mules.
25	1, 2, and 3	
26	—	Guard for headstocks of self-acting mules including rim pulley and taking in scrolls.
27	—	Guard for rim band tightening pulleys of self-acting mules.
28	1 and 2	Guard for duck-bill and heater of loose reed loom.

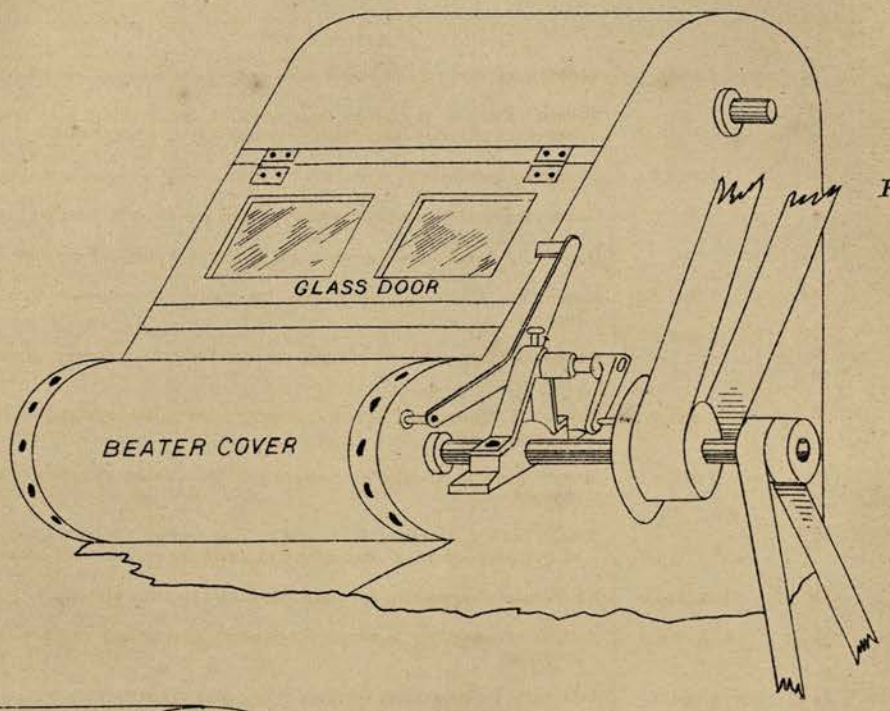

FIG.1.

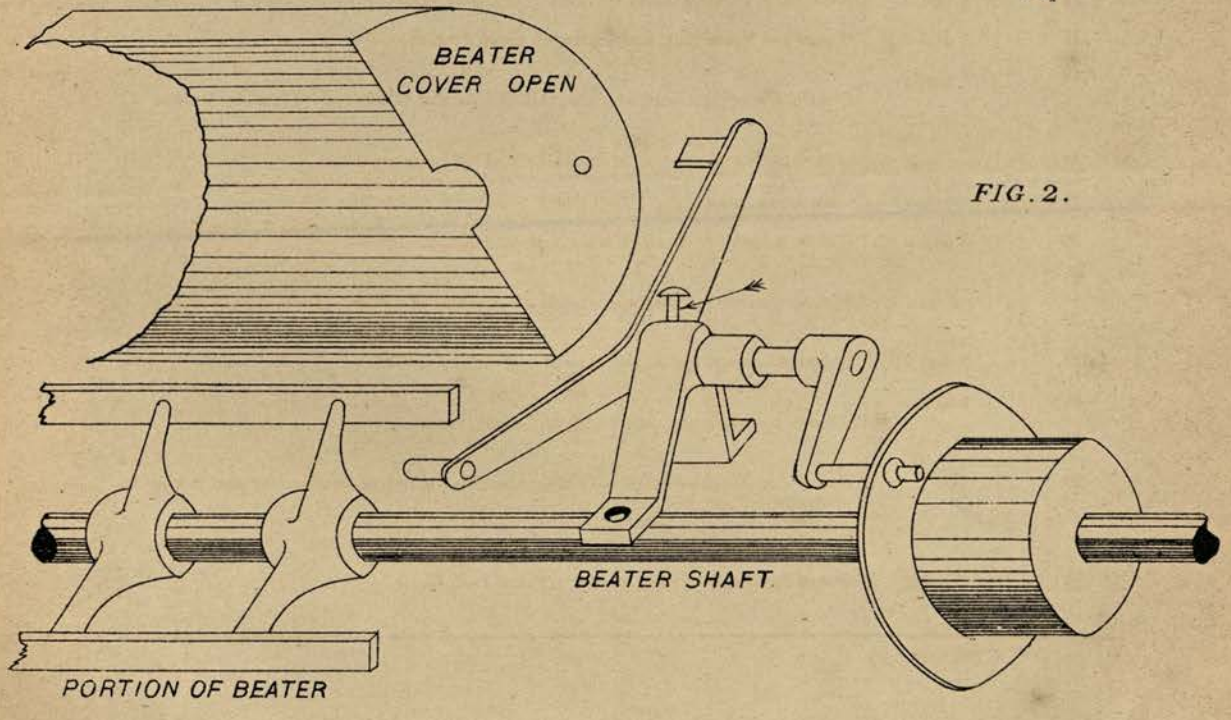

FIG.2.

LOCKING MECHANISM FOR BEATER COVERS & GLASS DOORS OF SCUTCHER.

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MESSRS WITHAM & LORDS ARRANGEMENT FOR LOCKING THE BEATER COVERS OF SCUTCHERS TILL THE BEATER SHAFT IS COMPLETELY AT A STANDSTILL.

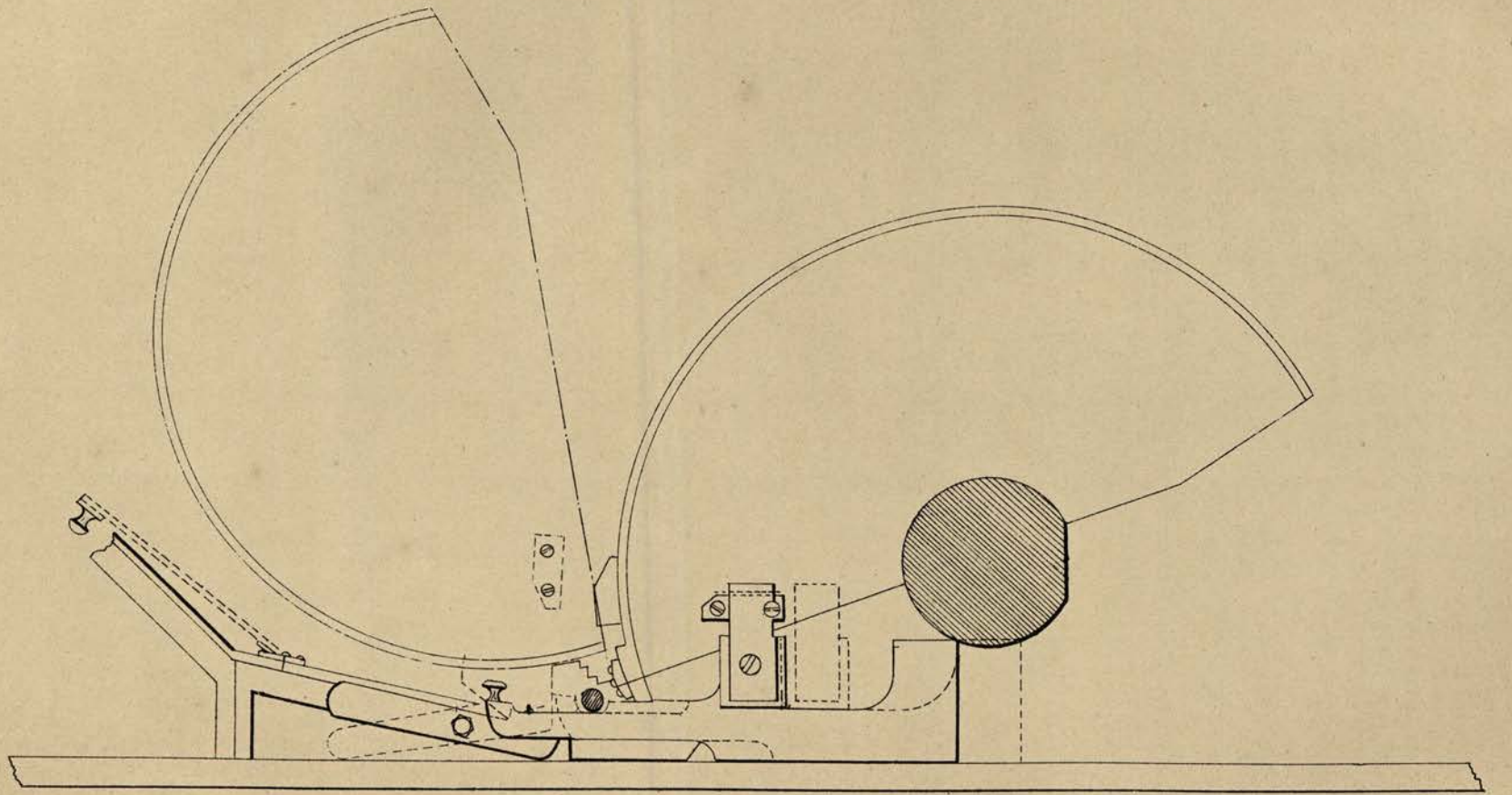

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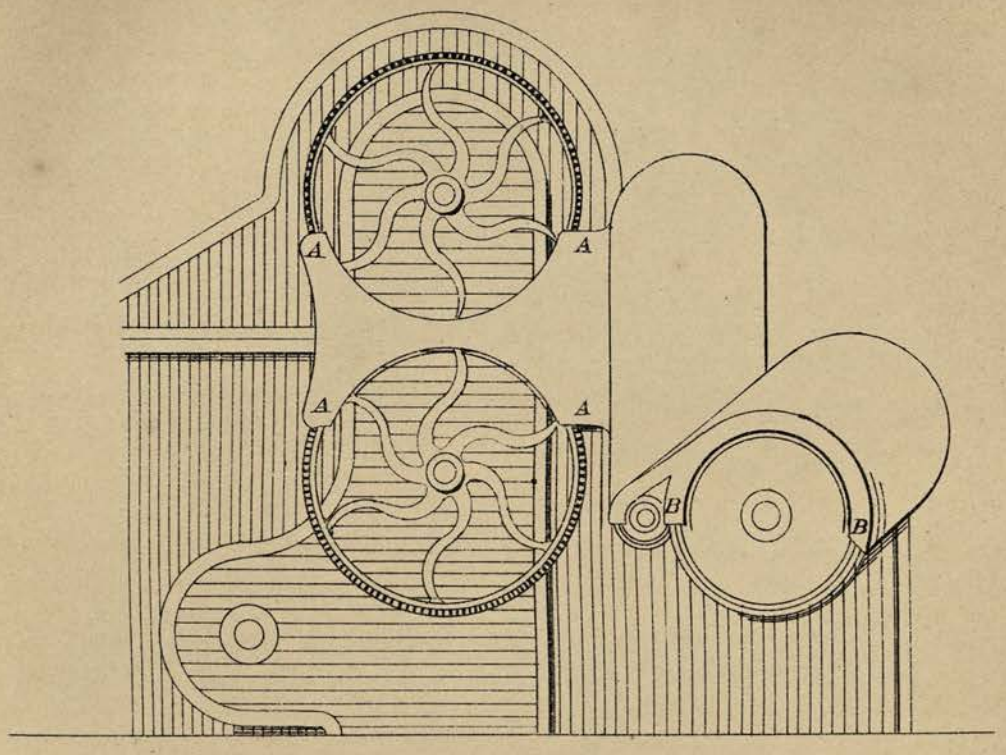
FIG. 1.

SCUTCHERS &c.



INCOMPLETE GUARDS FOR SPUR-WHEELS

(The points of danger are marked A.A and B.B. respectively)

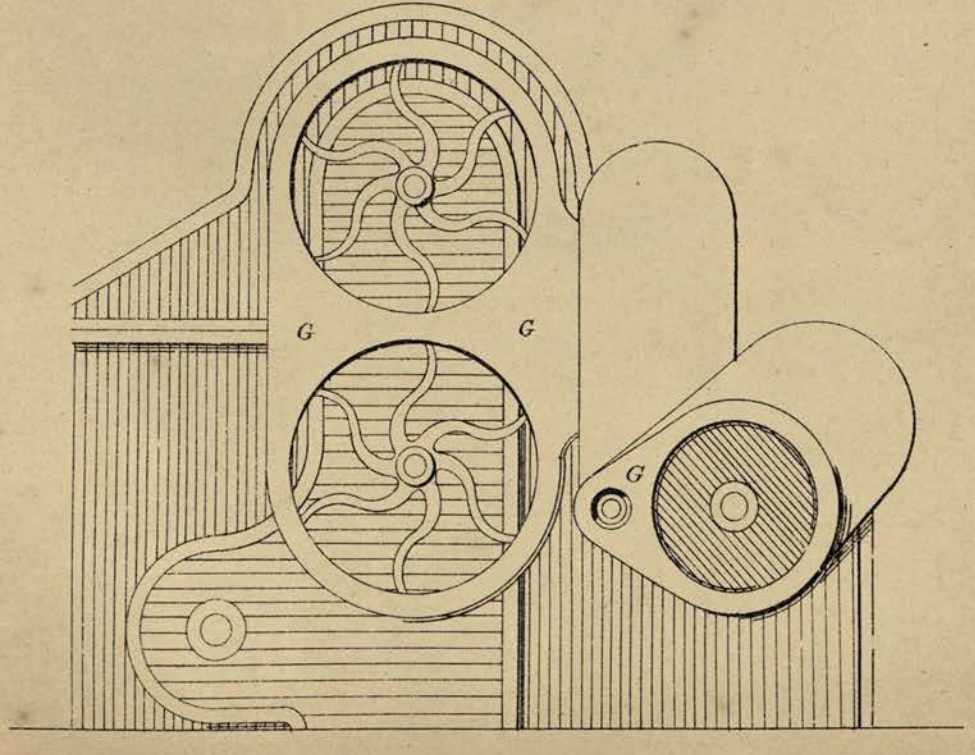


FIG. 2.

SPUR-WHEELS, WITH SUITABLE GUARDS G.G.

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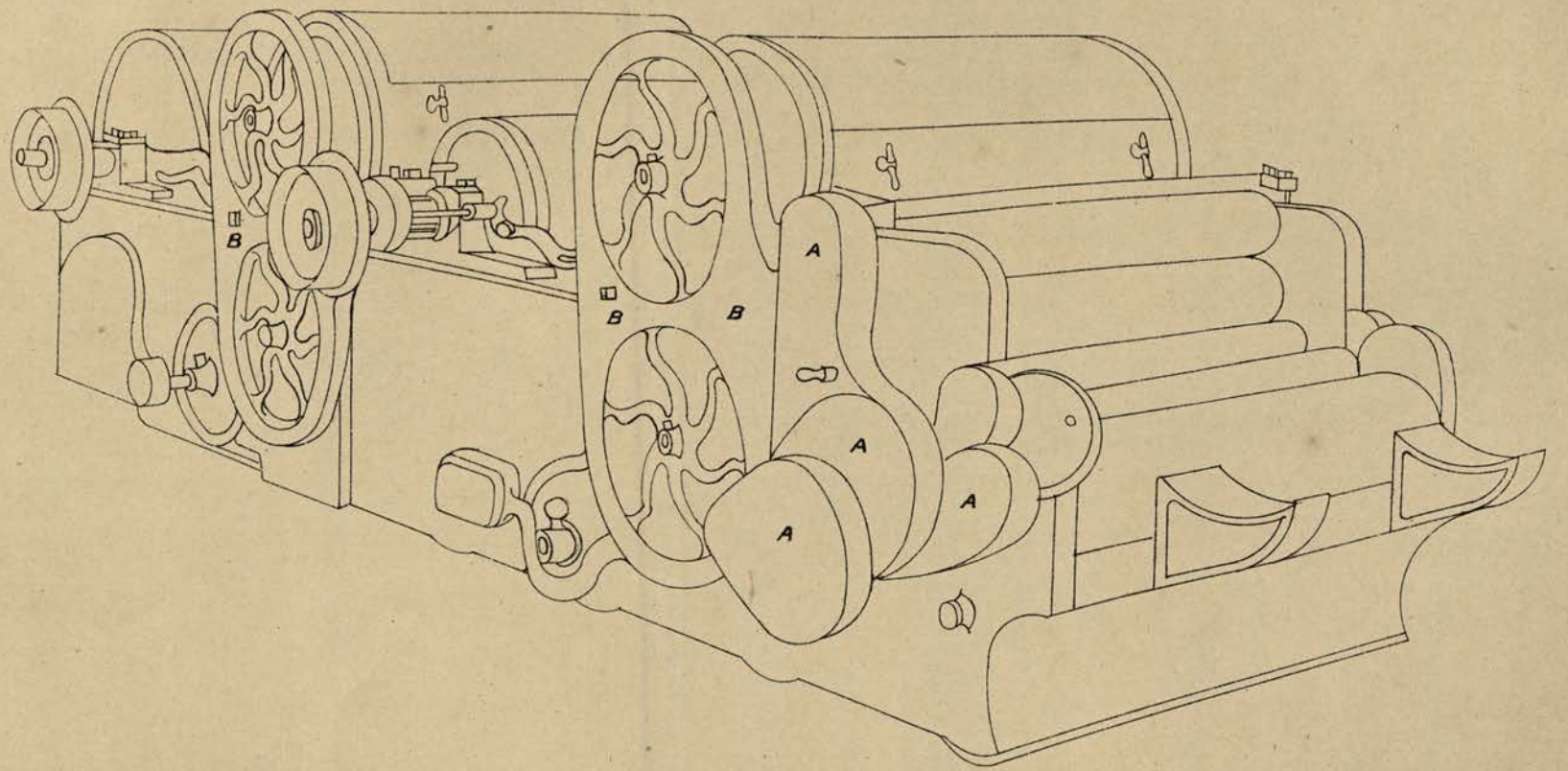

EXHAUST OPENER

Showing complete guards to calender gearing A. A. and to armed caged wheels B.

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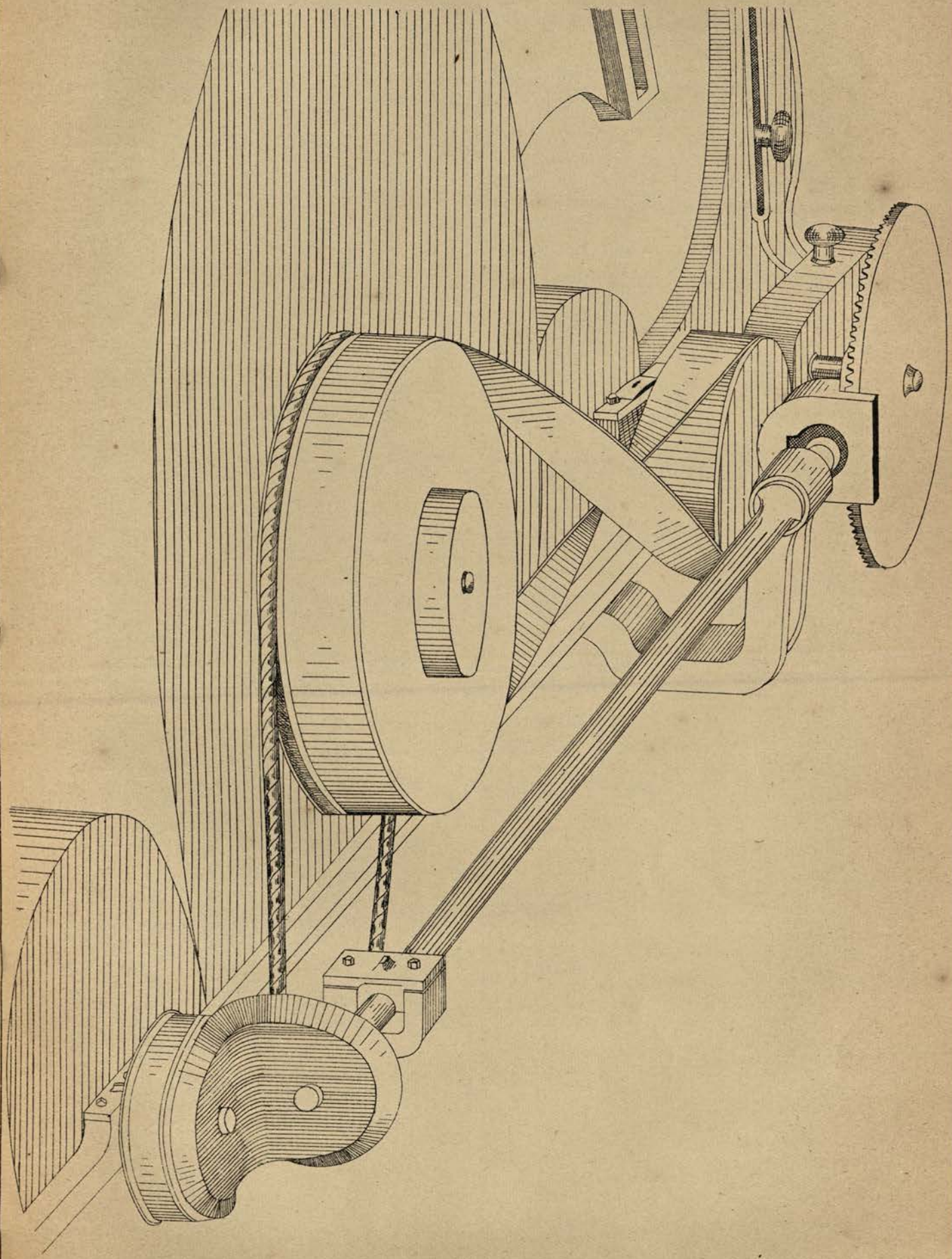
CARDING ENGINES



Shows approved guards for bevel wheels at each end of the side shaft.

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CARDING ENGINES

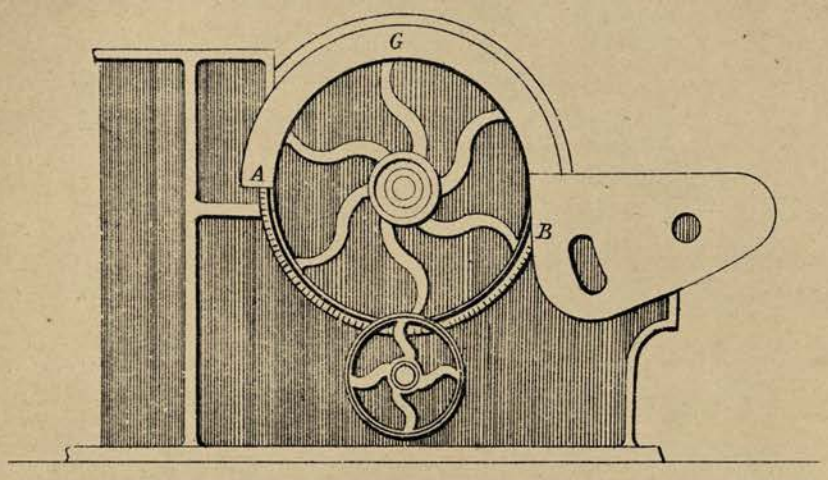

FIG. 1.

Shows an incomplete guard for spur-wheel at Doffer end of Carding Engine.
(The dangerous places are A and B)

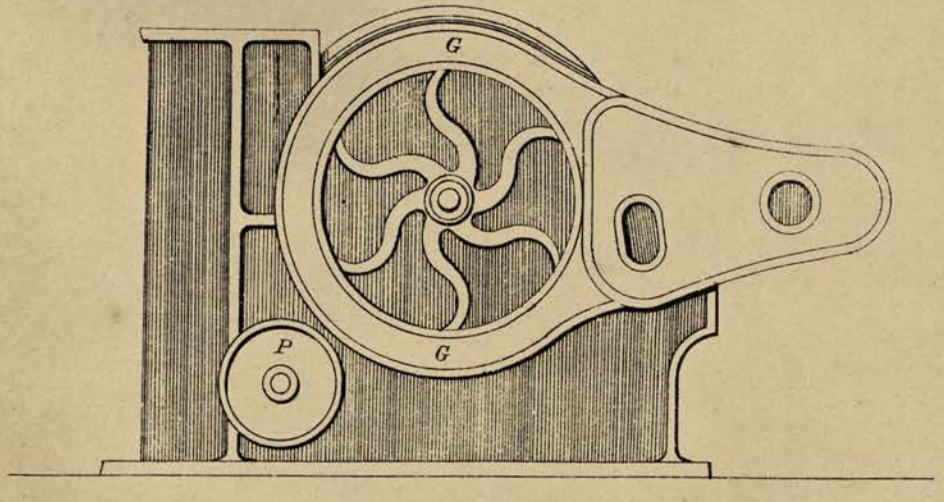

FIG. 2.

Shows a more complete guard for spur-wheel similar to the above

The small belt-pulley P is shown in this case as a plate wheel, instead of with four arms as above.

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MESSRS WITHAM & LORDS LOCKING MOTIONS FOR CYLINDER COVERS OF CARDING ENGINES

FIG. 1

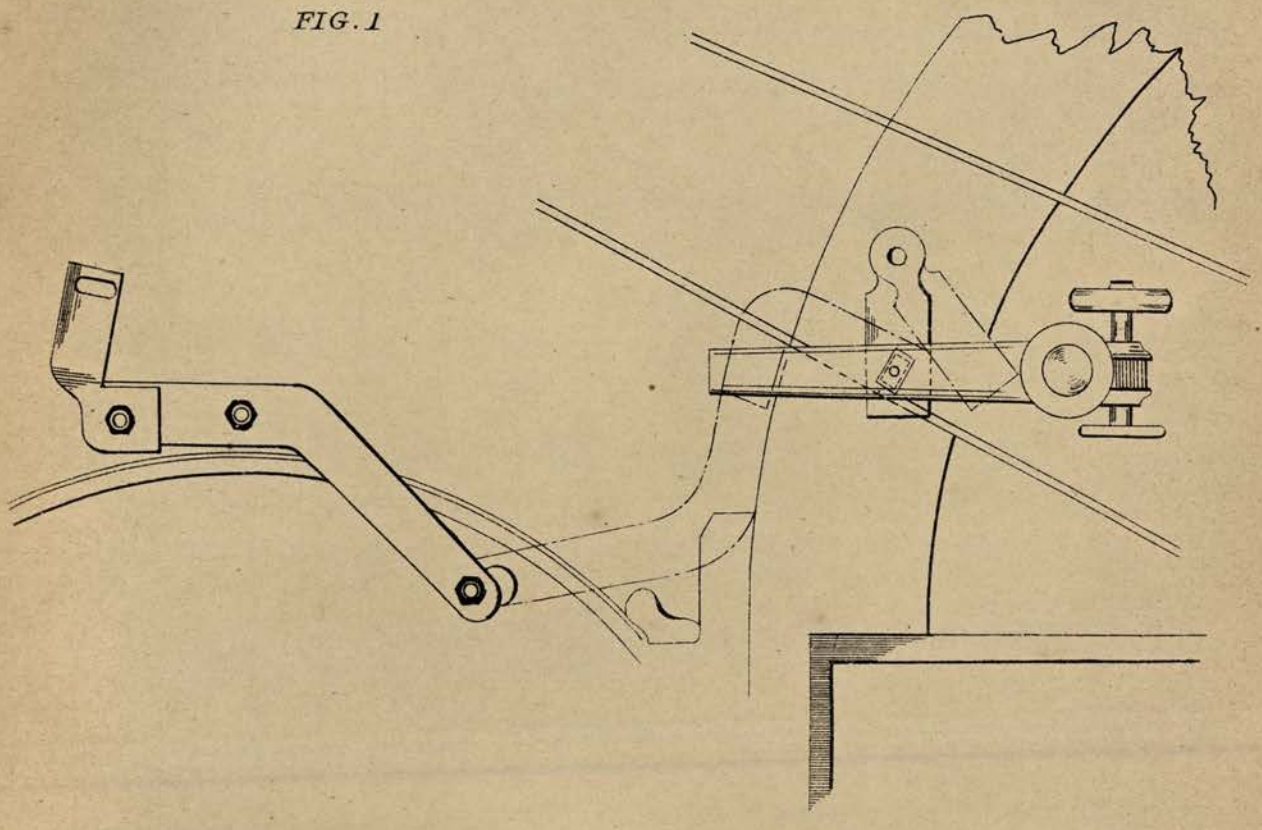
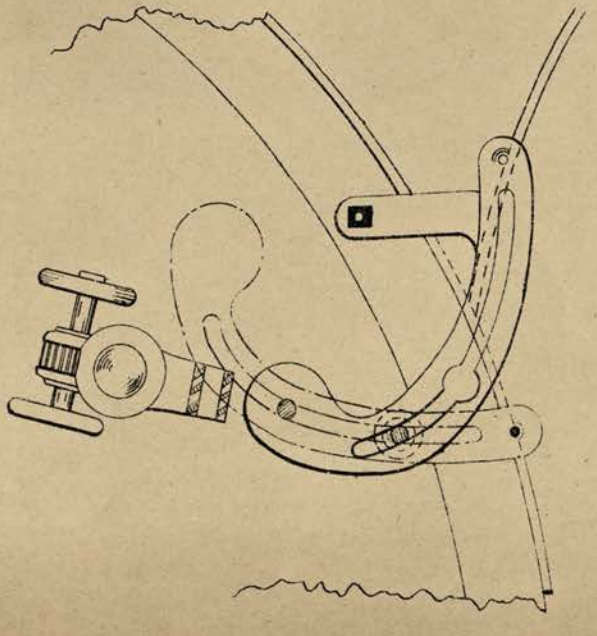


FIG. 2



Weller & Graham, Ltd. Litho. London

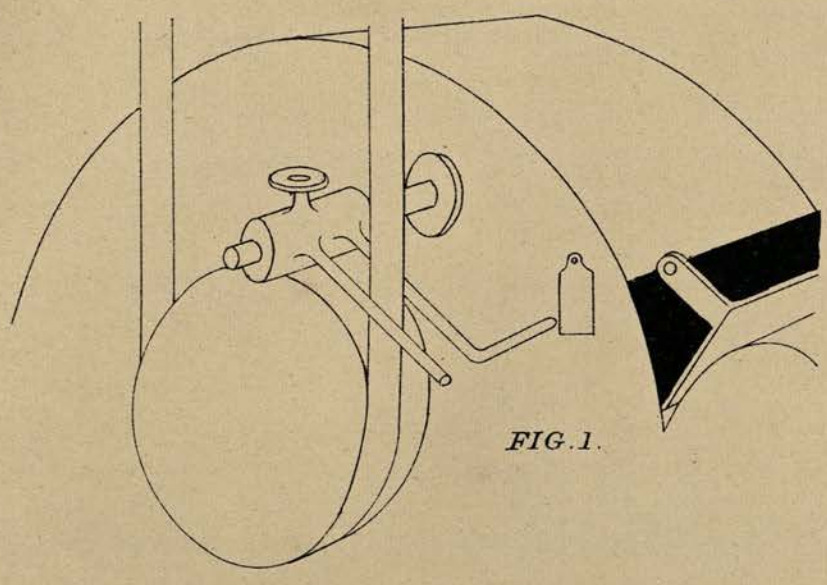


FIG. 1.

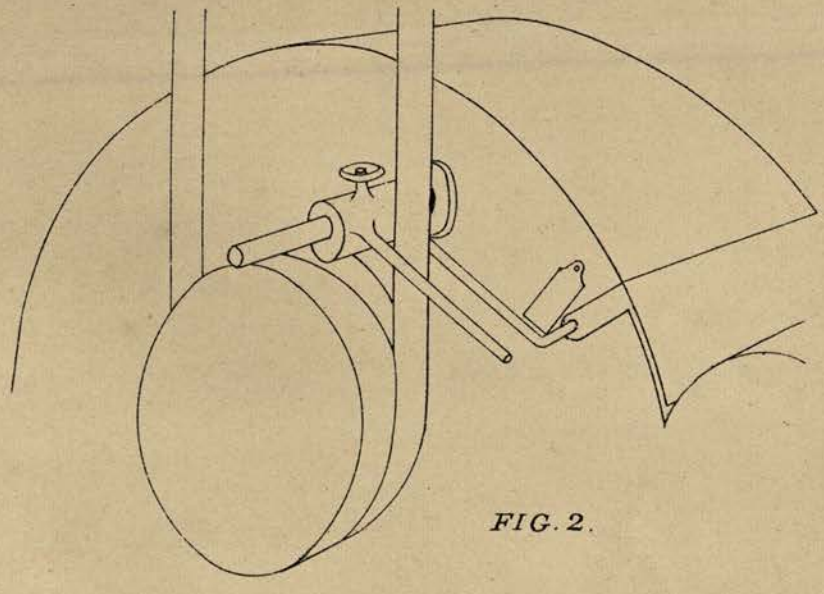


FIG. 2.

LOCKING MOTION FOR CARDING MACHINE

510 8 06

Weller & Graham, Ltd Litho. London

MESSRS THOMPSON & SONS LOCKING MOTION FOR CYLINDER COVERS OF CARDING ENGINES.

FIG. 1.

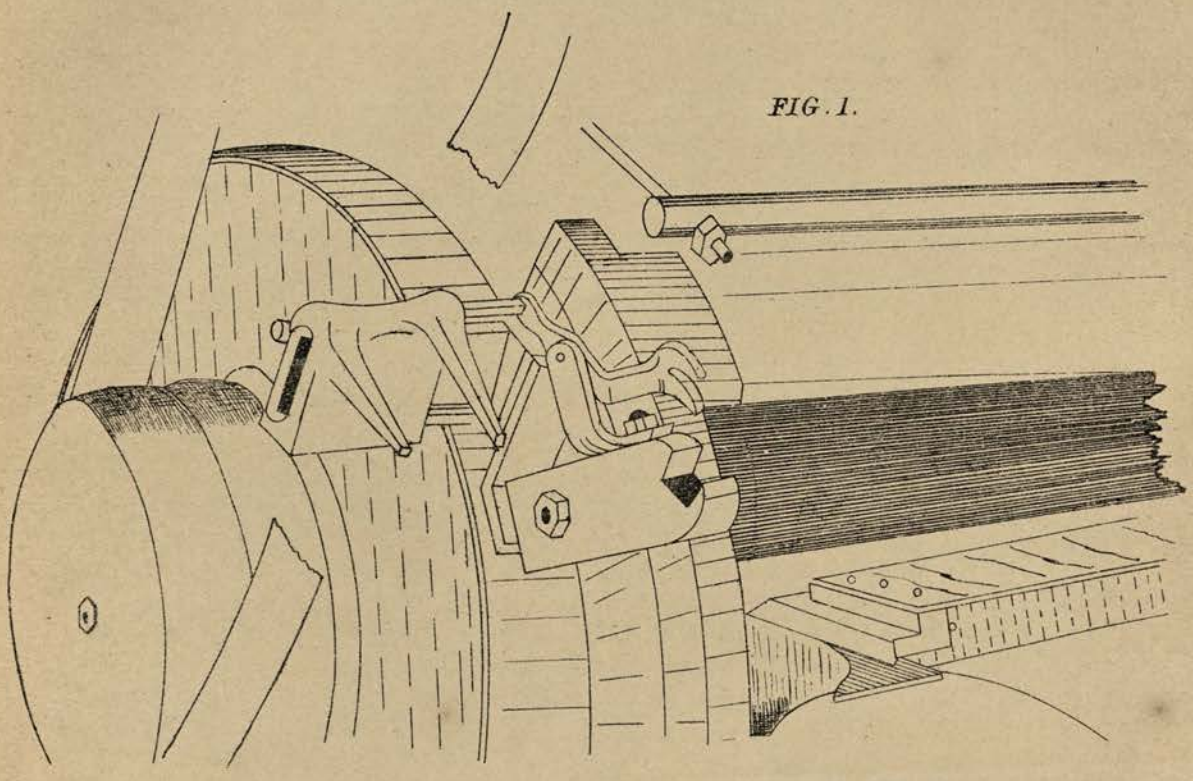
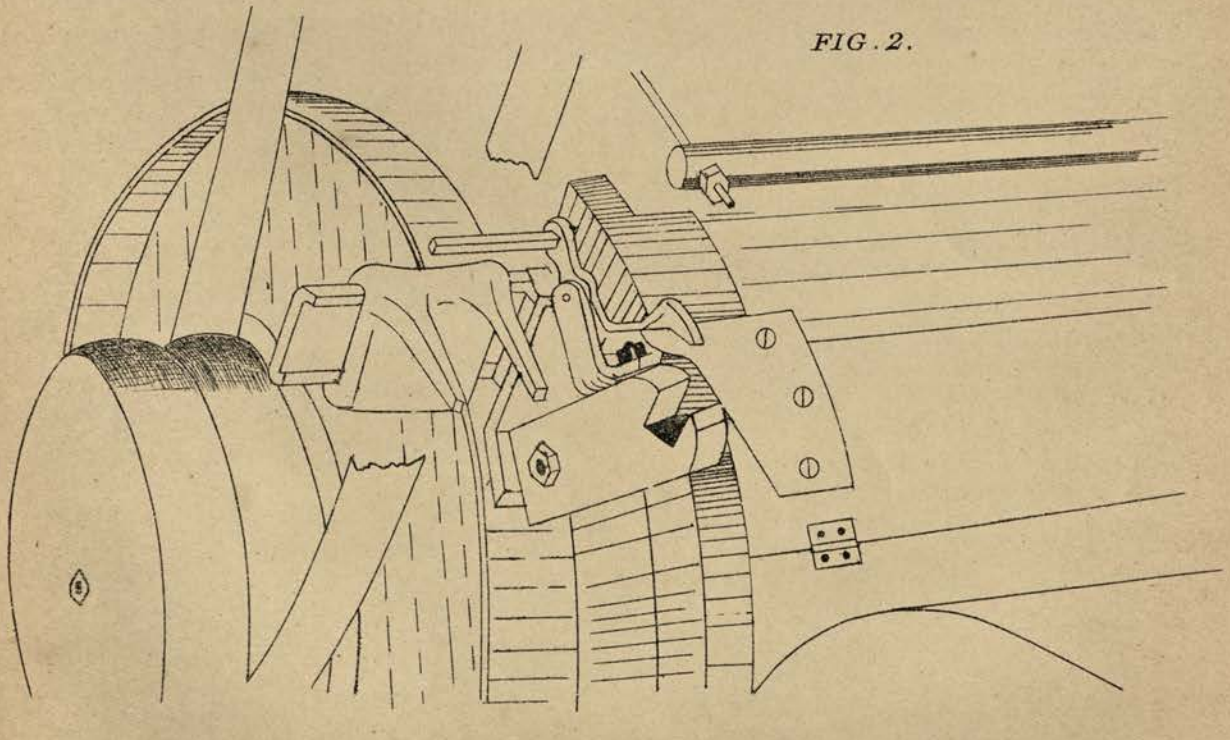


FIG. 2.



310.8.06

Weller & Graham, Ltd Litho London.

FIG. 1.

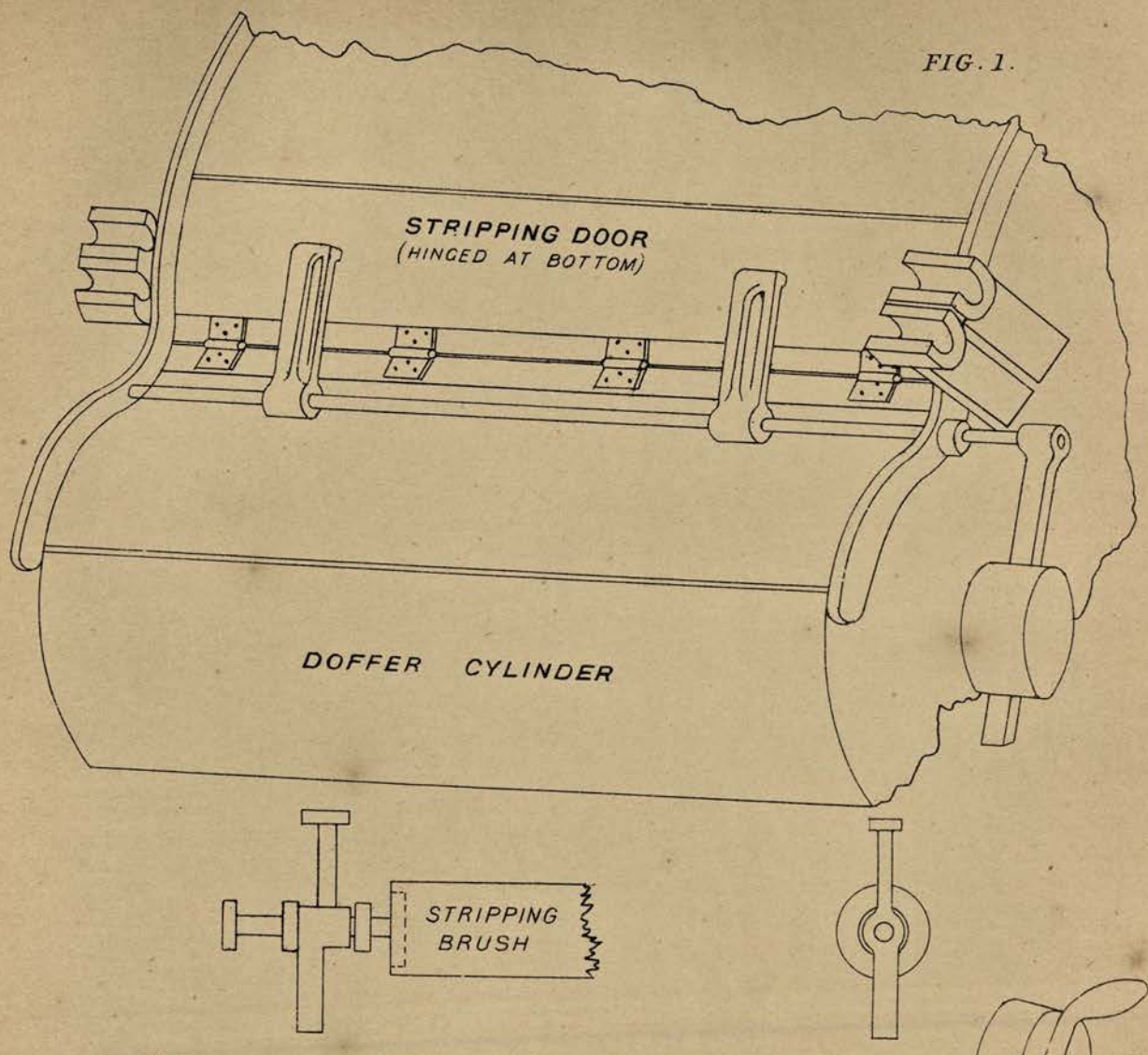
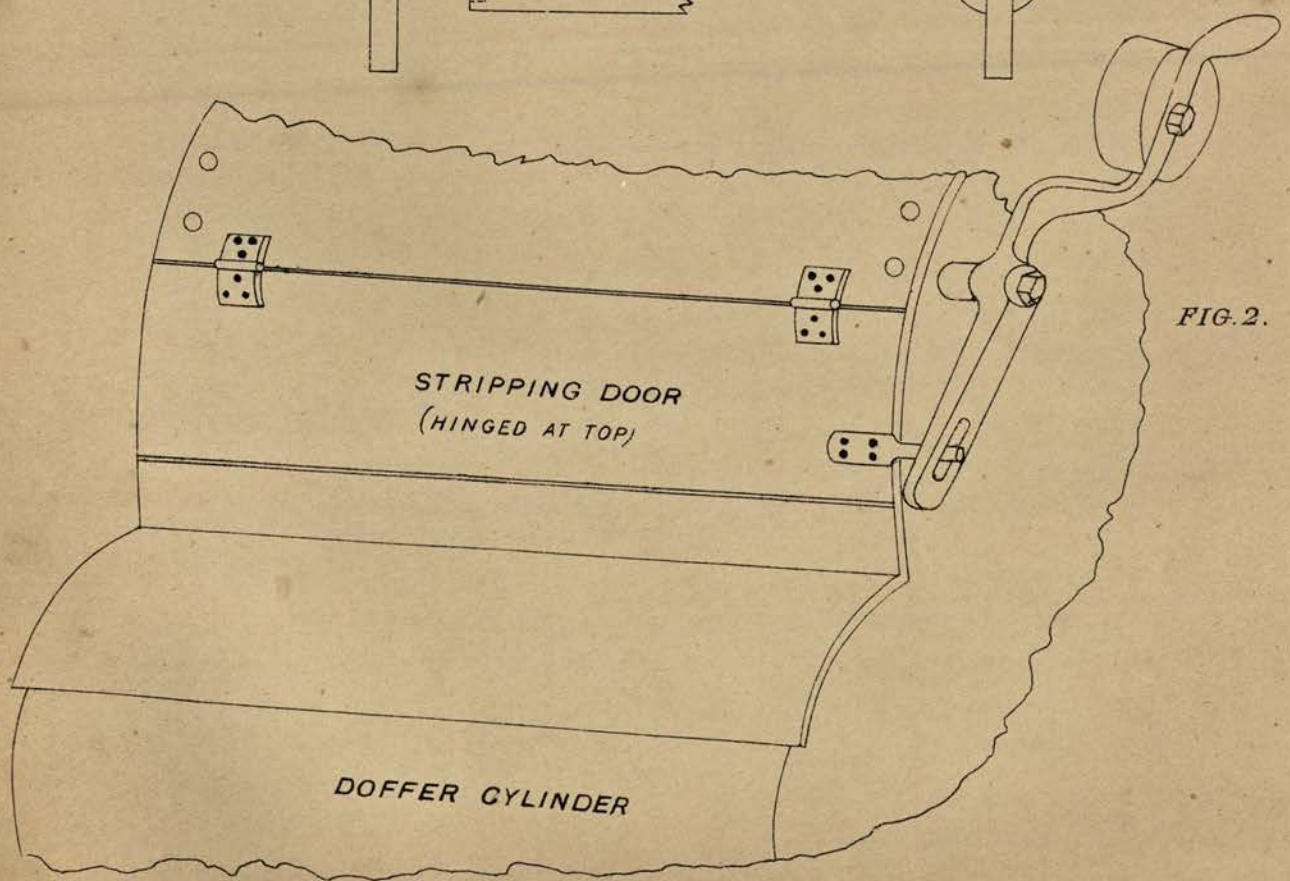


FIG. 2.

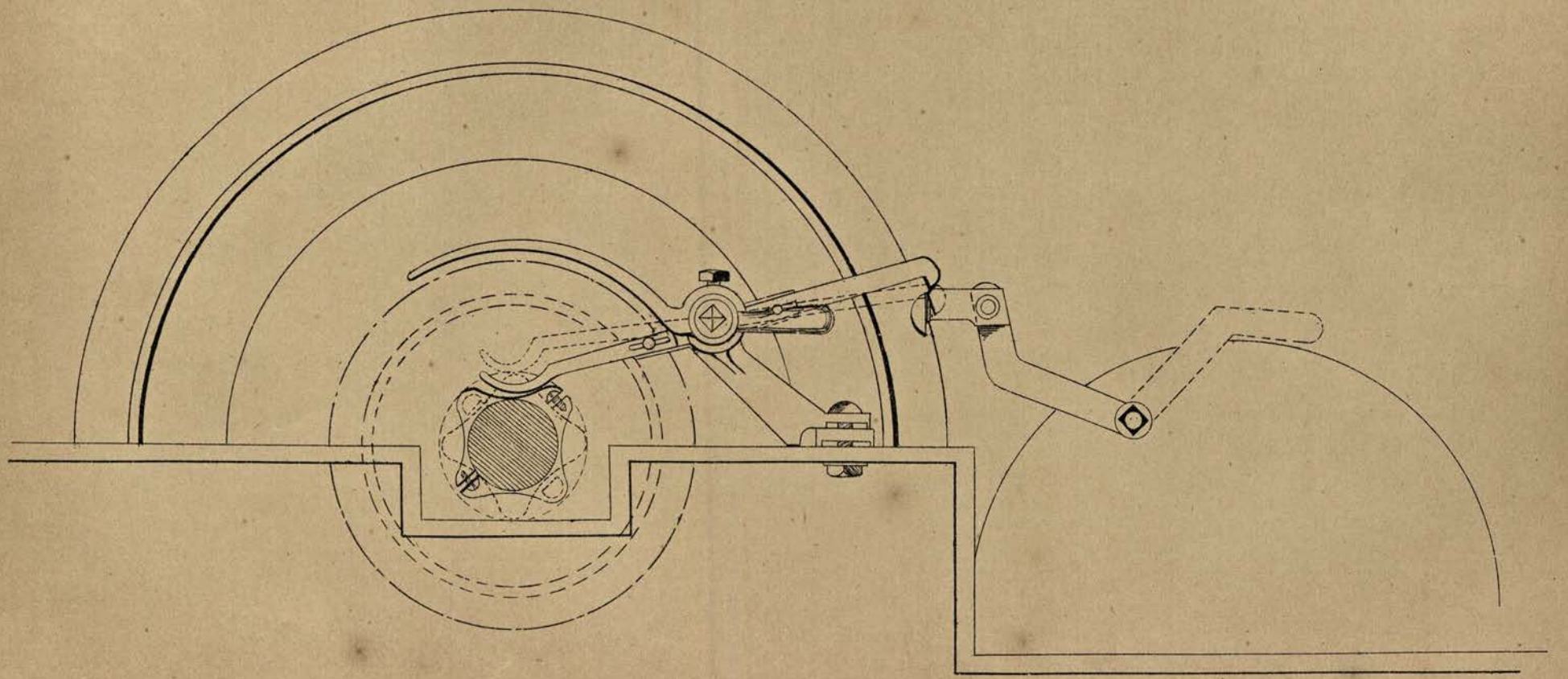


LEES & SMALLEY'S ARRANGEMENT FOR CLOSING STRIPPING DOORS

510. 8. 06

Weller & Graham, Ltd. Litho. London.

MESSRS CATLOW, MARSDEN AND DUNN'S LOCKING MOTION FOR PREVENTING THE OPENING OF THE CYLINDER COVER OF CARDING ENGINES TILL THE CYLINDER HAS CEASED TO RUN

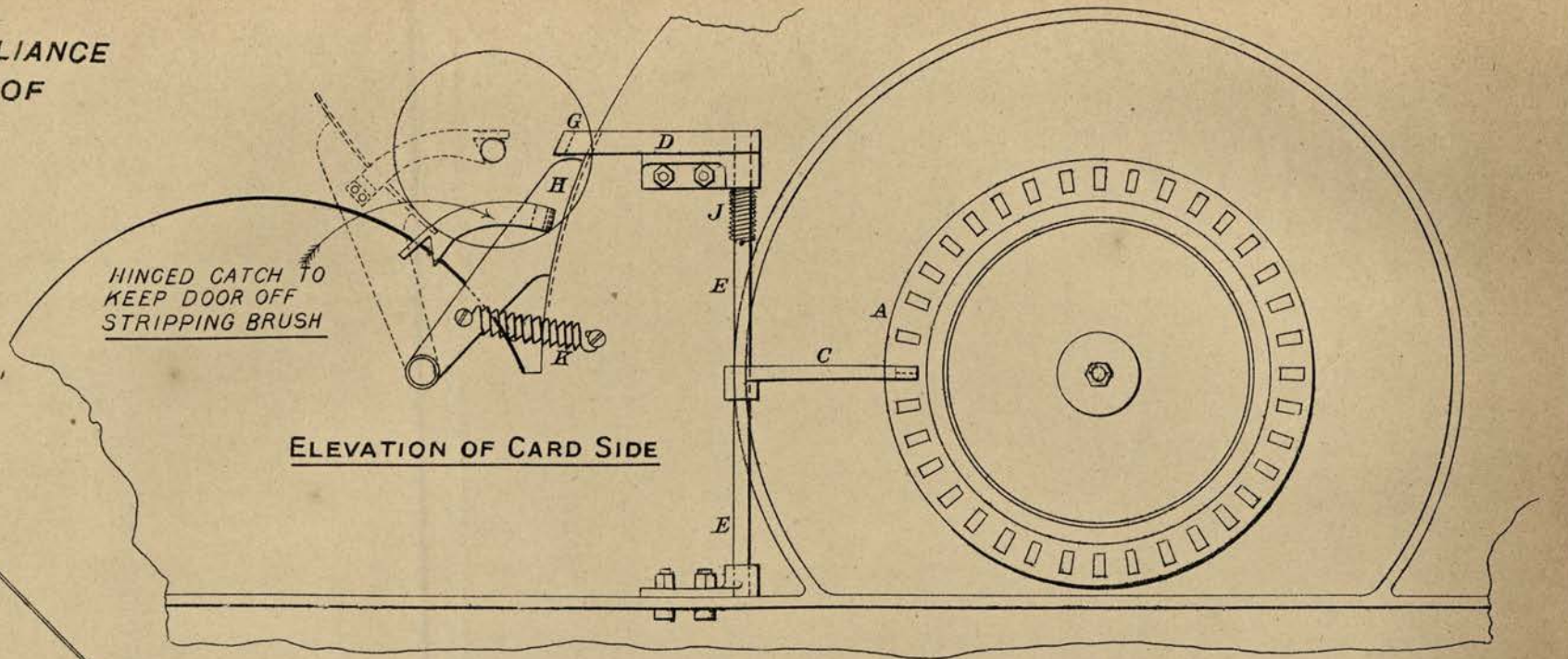


510.8.00

Weller & Graham, Ltd Litho. London

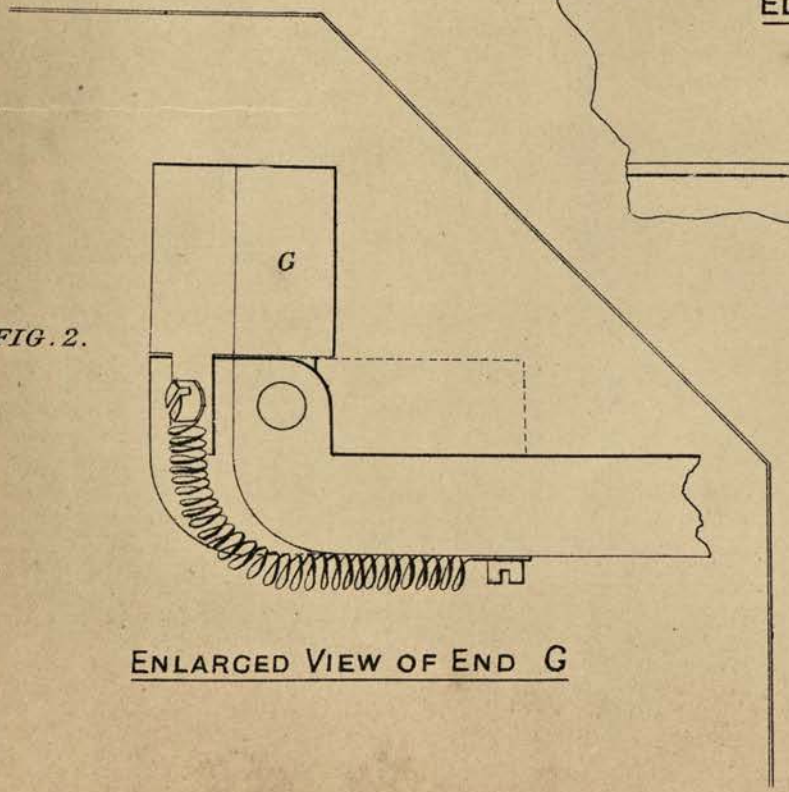
SAFETY LOCKING APPLIANCE FOR STRIPPING DOORS OF CARDING ENGINES.

FIG. 1.



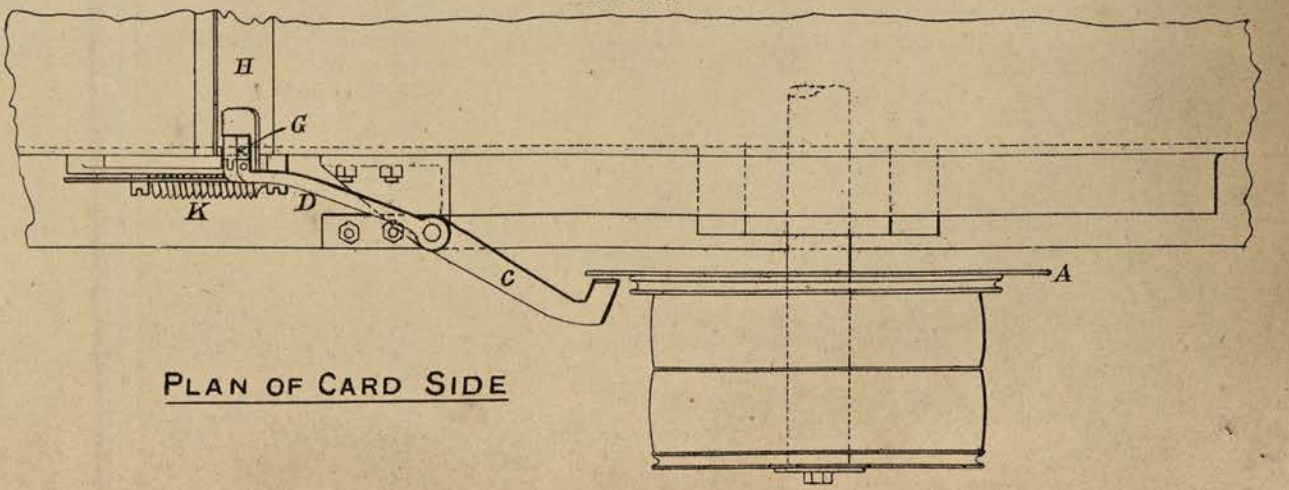
ELEVATION OF CARD SIDE

FIG. 2.



ENLARGED VIEW OF END G

FIG. 3.



PLAN OF CARD SIDE

510. B. 06

Weller & Graham, Ltd Litho. London.

METHOD OF REVERSING MOTION OF CARDING ENGINE CYLINDER AND DOFFER FOR PURPOSE OF GRINDING

END ELEVATION

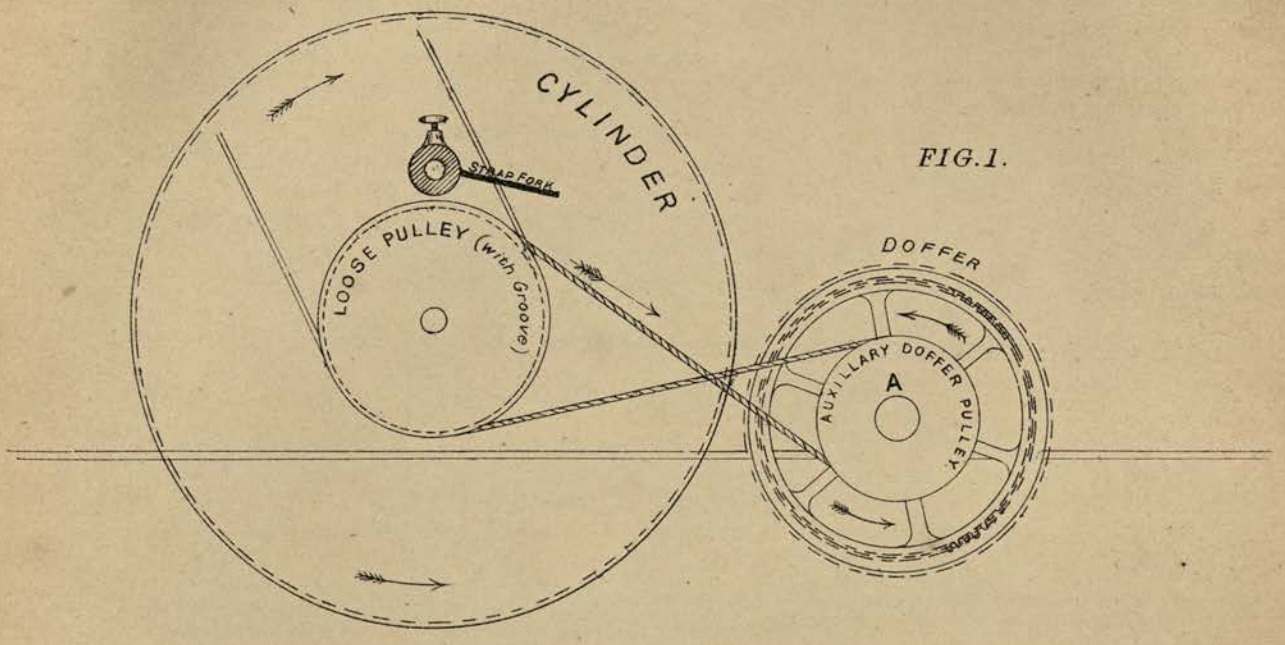
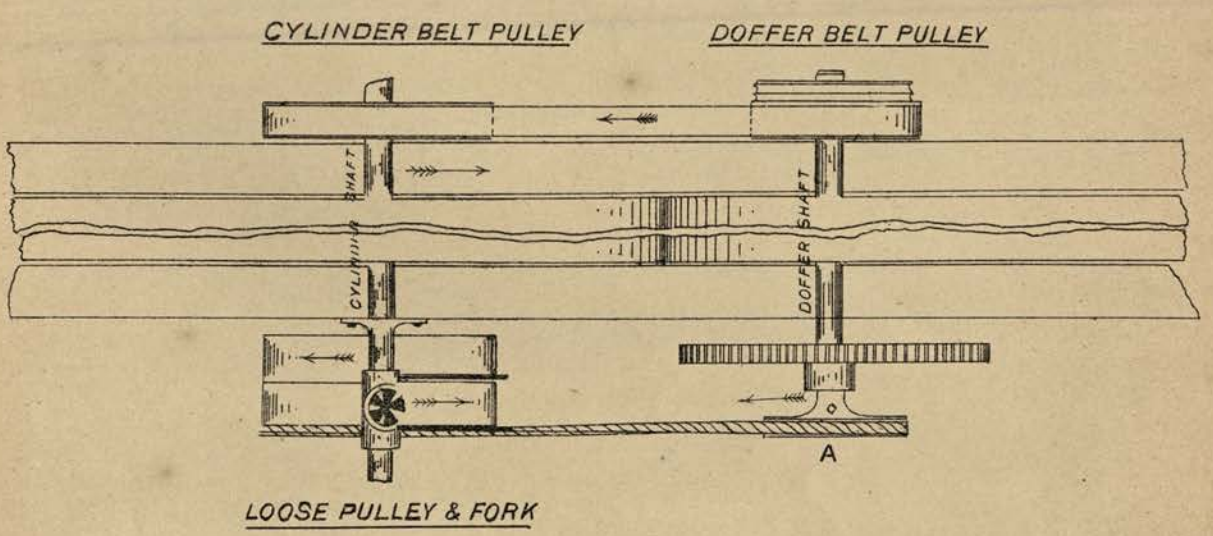


FIG. 1.

PLAN

FIG. 2.



LOOSE PULLEY & FORK

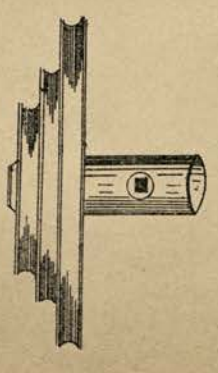


FIG. 3.

THREE GROOVED PULLEY

S10. 8. 06

Weller & Graham, Ltd Litho. London.

AUTOMATIC LOCKING DOORS FOR BACK GEARING OF SPEED FRAMES.

FIG. 1.

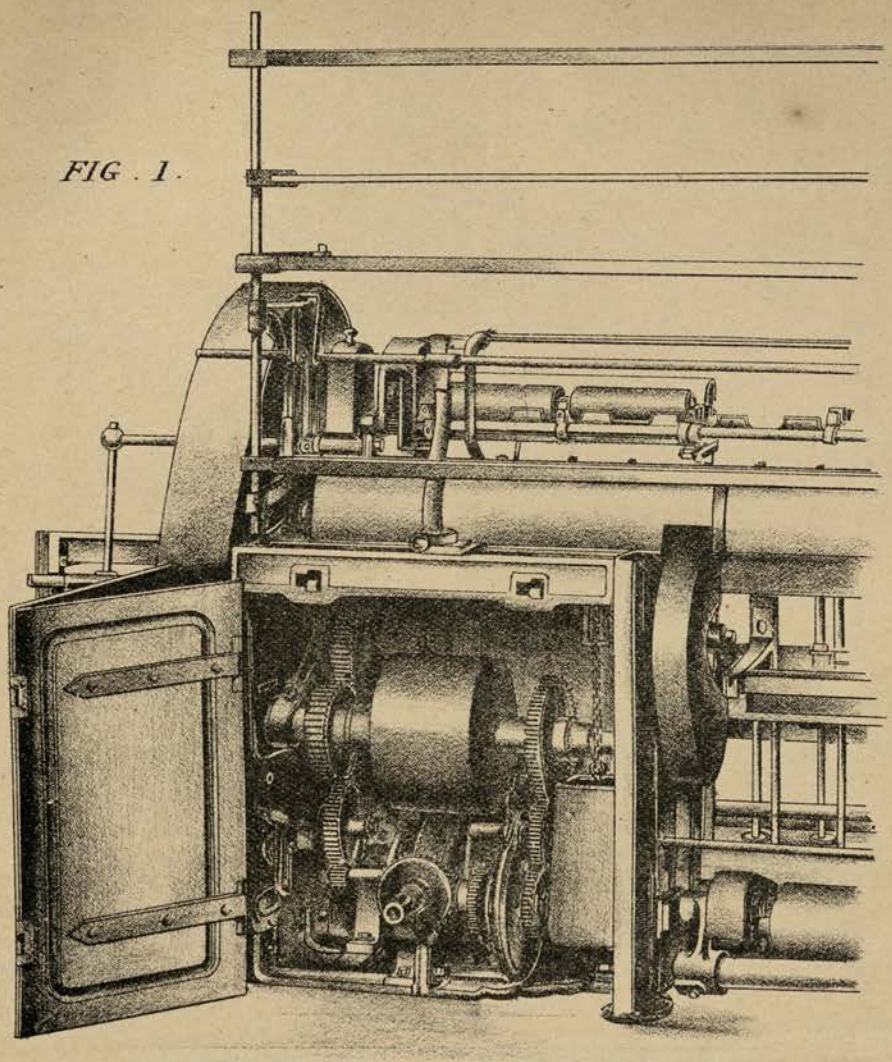
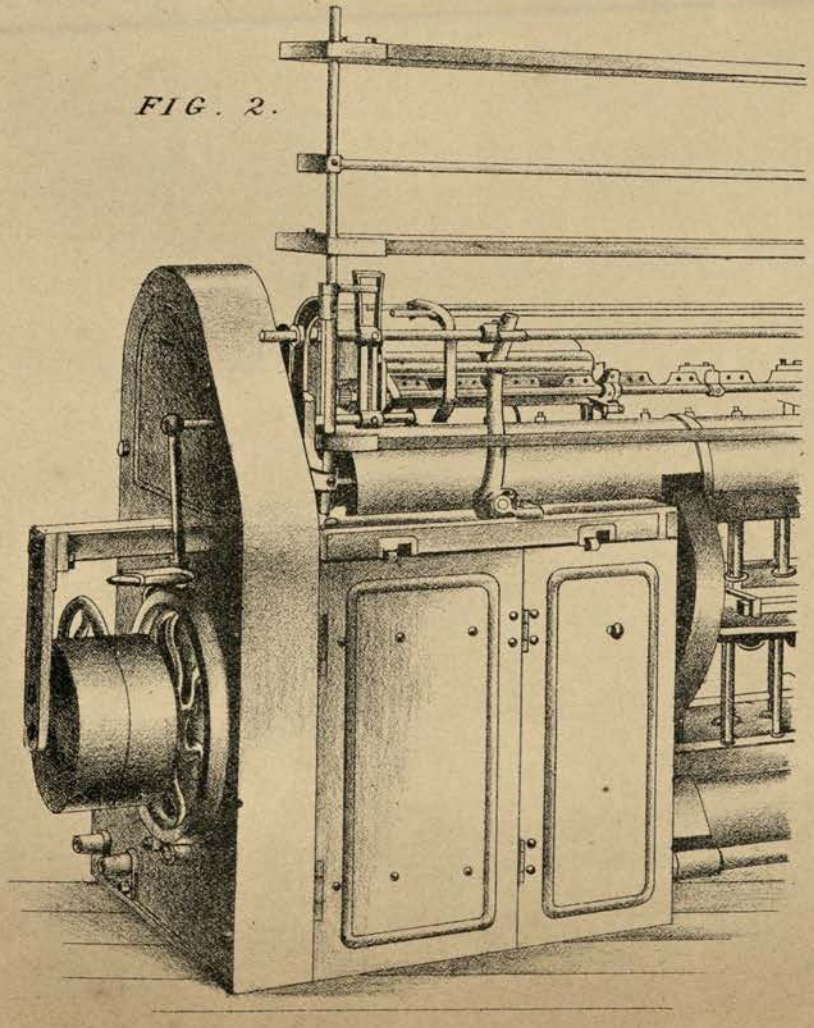


FIG. 2.



510. 8·05.

Weller & Graham. Ltd Litho London.

FIG . 1 .

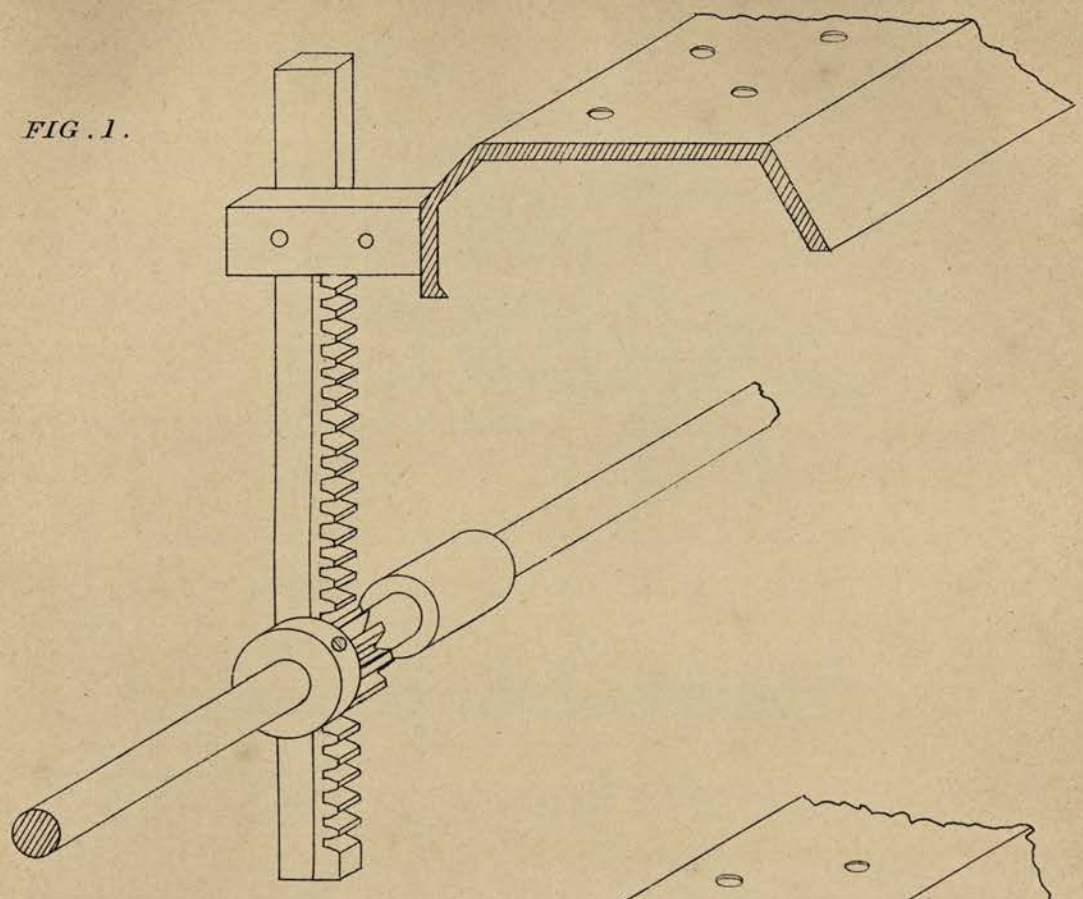
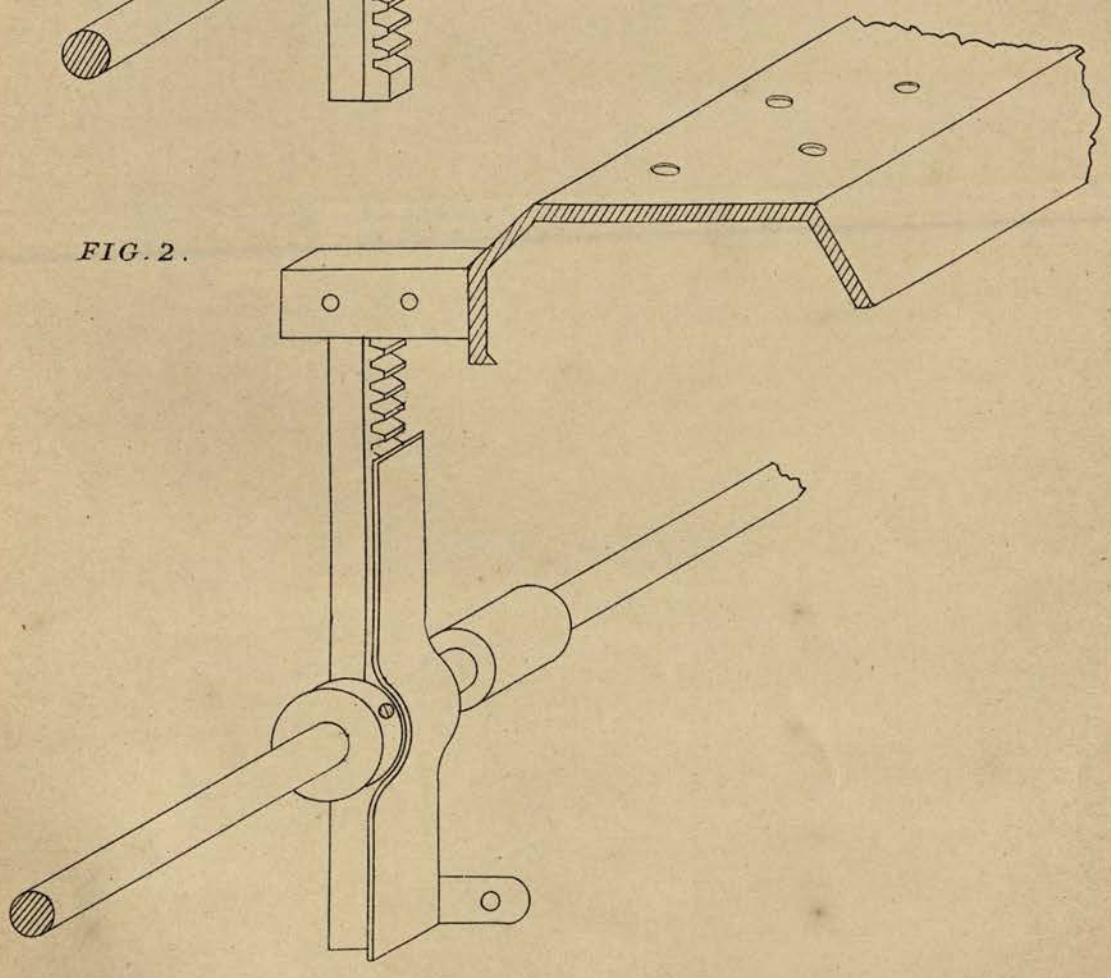


FIG . 2 .



LIFTER RACK & PINION OF ROVING FRAME & GUARD

510.8.06

Wellen & Graham, Ltd Litho, London.

FIG. 1.

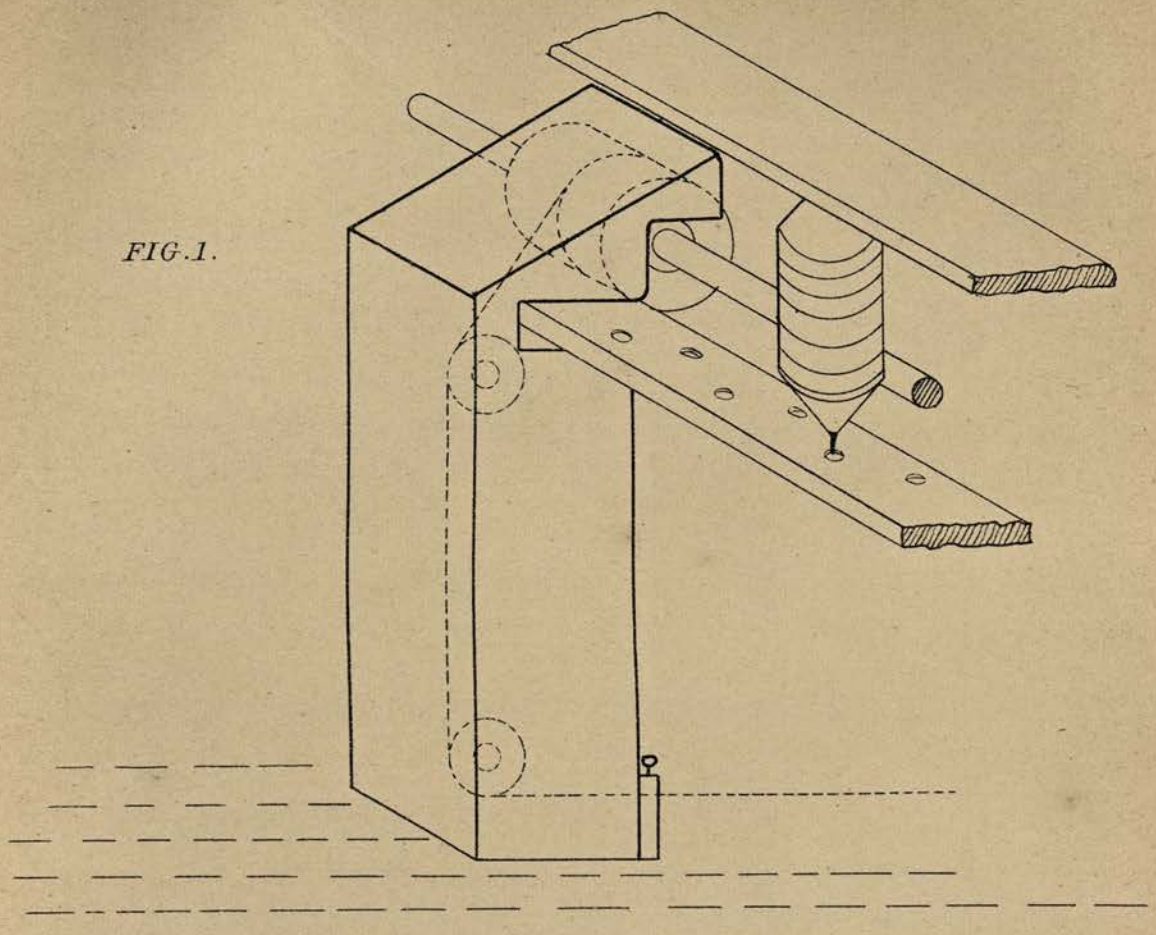
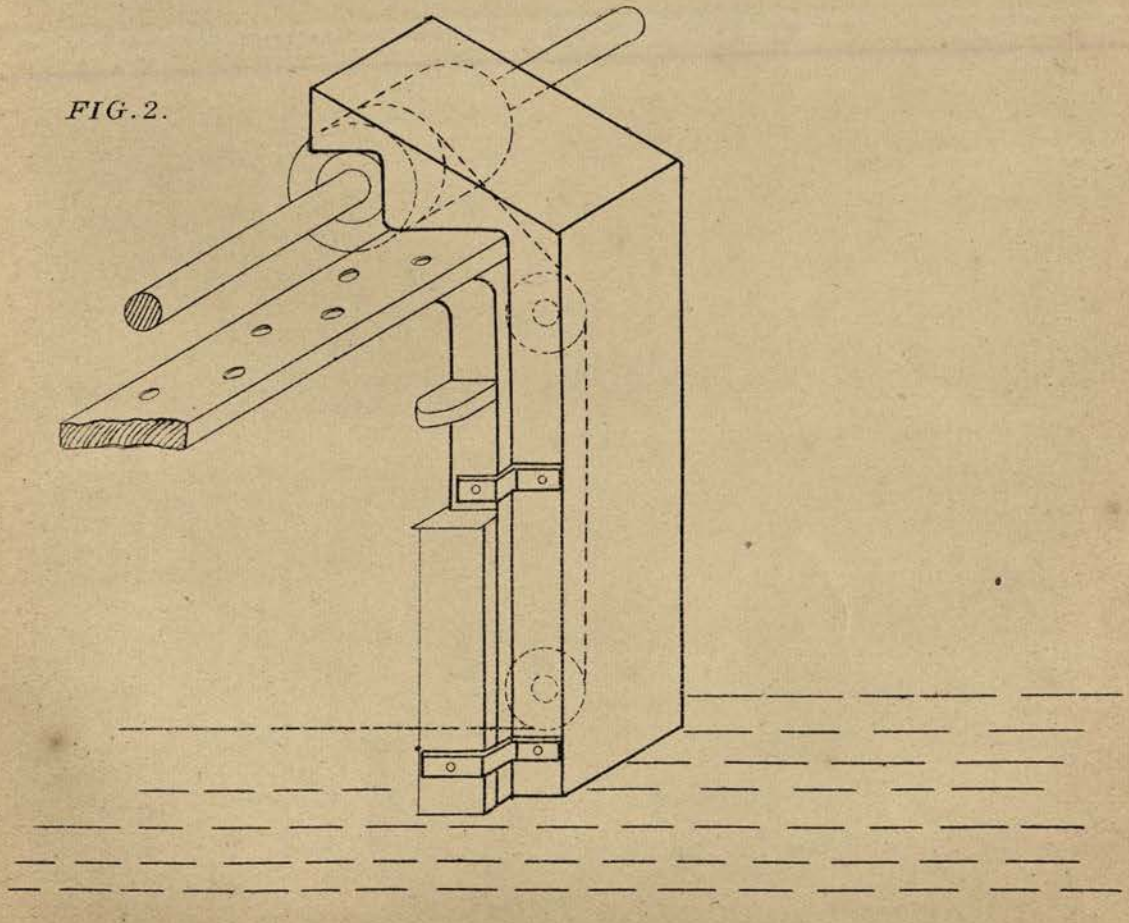


FIG. 2.



GUARD FOR MIDDLE BACK SHAFT SCROLLS & CARRIER PULLEYS

510. 8. 06

Weller & Graham, Ltd Litho. London

GUARD FOR MIDDLE DRAWING-OUT SCROLL BAND AND PULLEYS OF MULE.

FIG. 1.

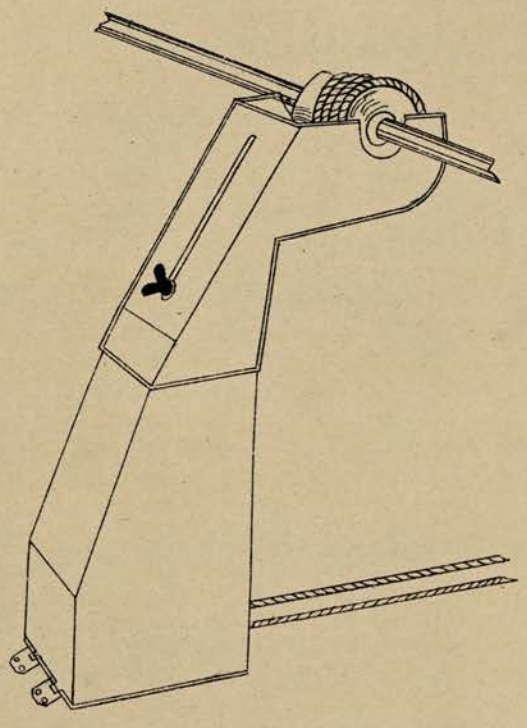
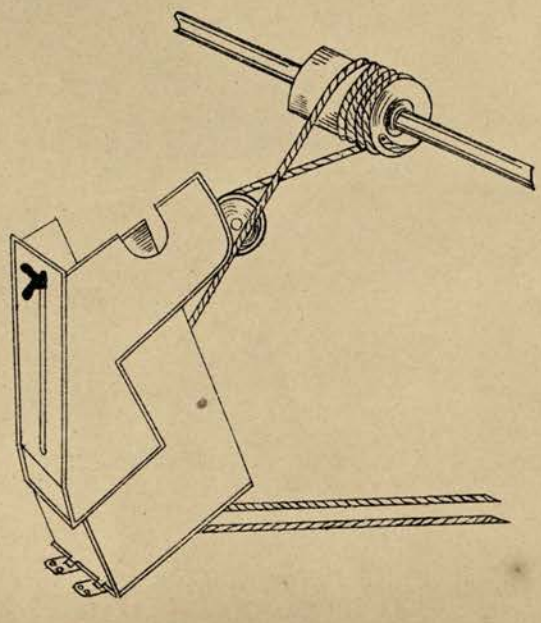


FIG. 2.



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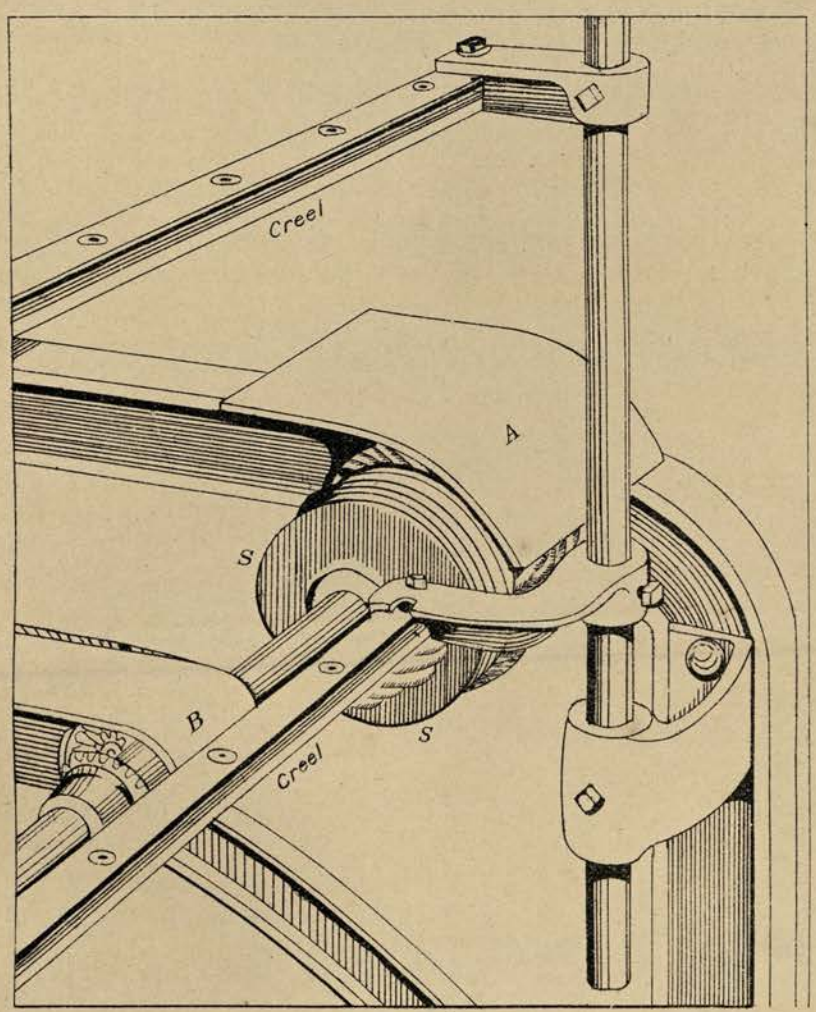
510. 6. 06

SELF-ACTING MULES



Shows a guard A for the full width of the scroll S on far end of back shaft
(This is very often either left bare or insufficiently covered by a narrow guard)
B is a guard over bevel-wheels.

510 8.08

Weller & Graham, Ltd · Litho. London.

SELF-ACTING MULES

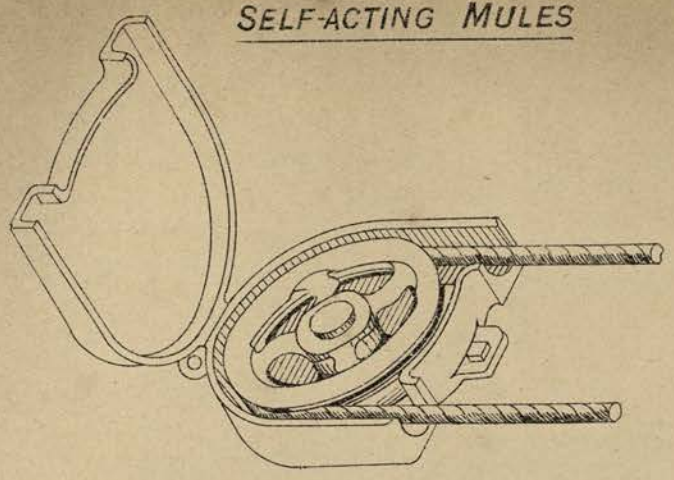


FIG. 1.

Hinged Guard for Horizontal band pulley
C, cover

SELF-ACTING MULES

GUARDS FOR THE DRAWING OUT BAND AND PULLEY AT THE OUT END OF FRAME

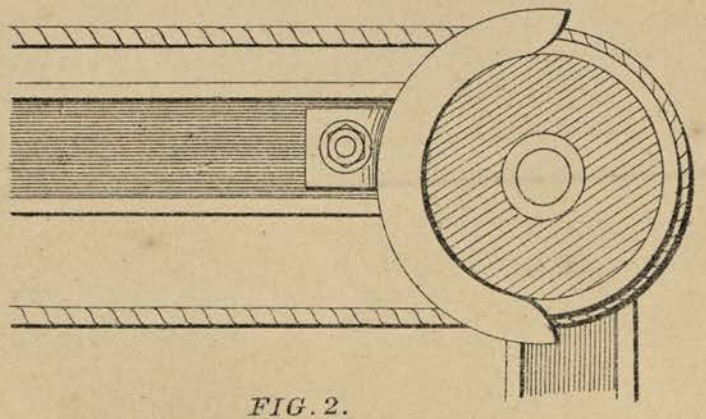


FIG. 2.

Shows an unsatisfactory Guard, A

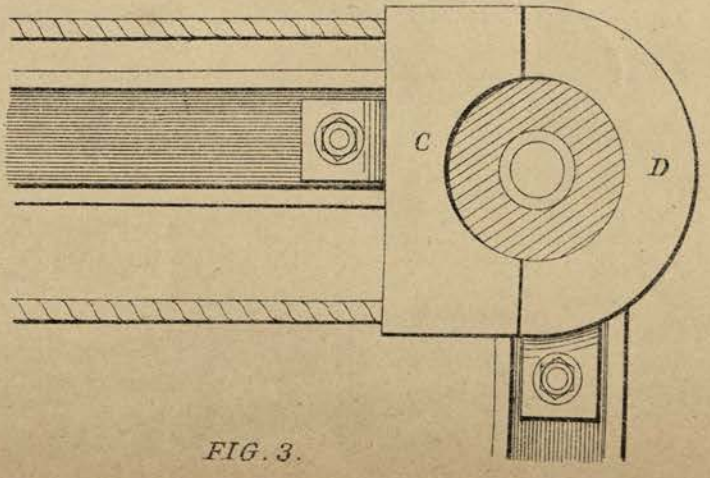


FIG. 3.

Shows a guard which completely covers the band round pulley. C. D.

510 6 26

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SELF-ACTING MULES

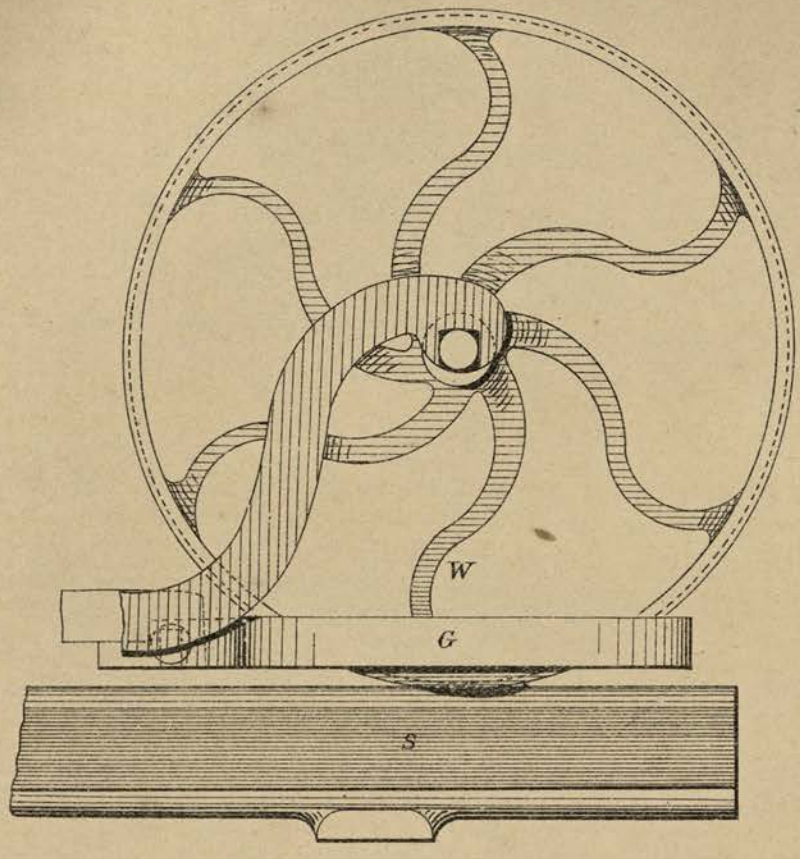

FIG. 1.

ELEVATION Foot Guard for Carriage Wheels

The Guard G is fixed to the bracket B and surrounds the Wheel W at a slight distance above the "slip" (or rail) S

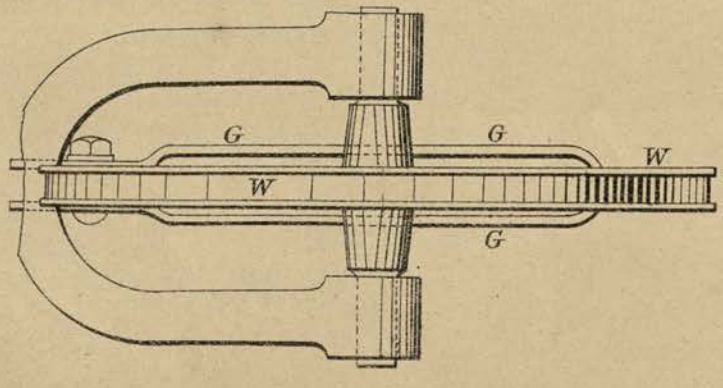

FIG. 2.

PLAN

510 B. 06

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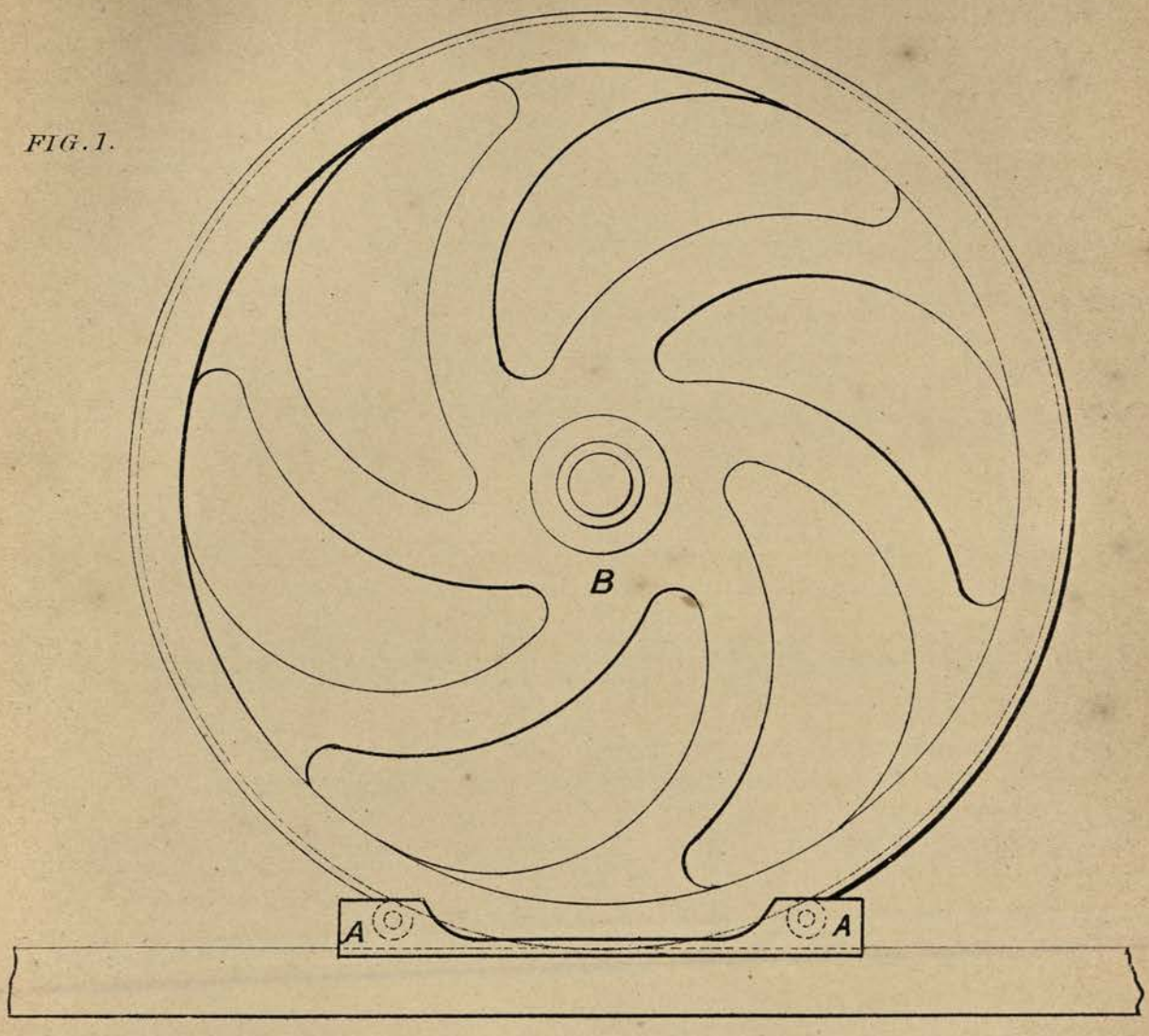
GUARD FOR MULE CARRIAGE WHEEL

FIG. 1.

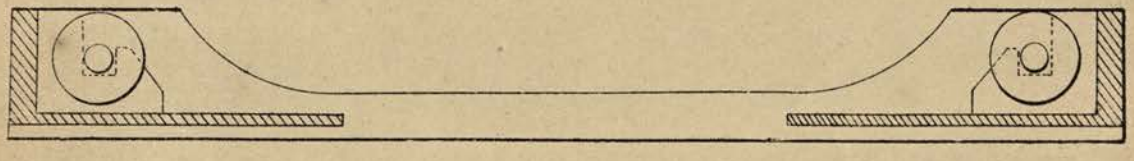


A ..... GUARD

B ..... CARRIAGE WHEEL

C ..... SLIP

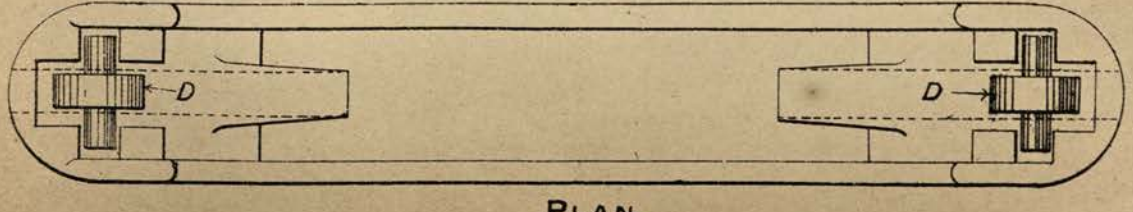
FIG. 2 SKETCH SHEWING GUARD IN POSITION WHEEL & SLIP.



SECTIONAL ELEVATION

D SMALL STEAM ROLLER

FIG. 3



PLAN

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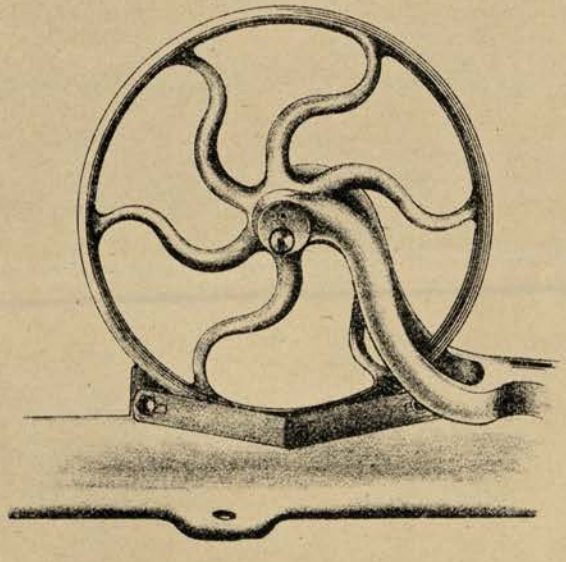
BOWKER, BUTTERWORTH, & Mc VAYS.

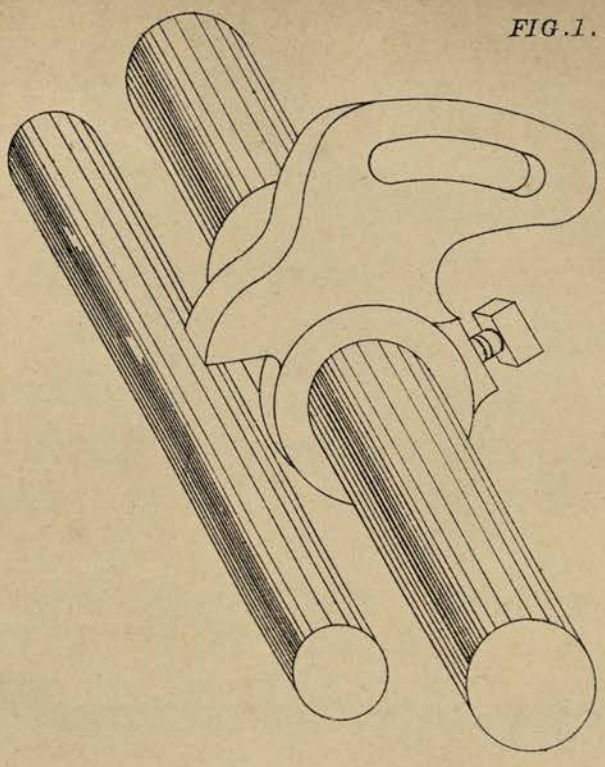
CARRIAGE WHEEL GUARD.



510.8.06.

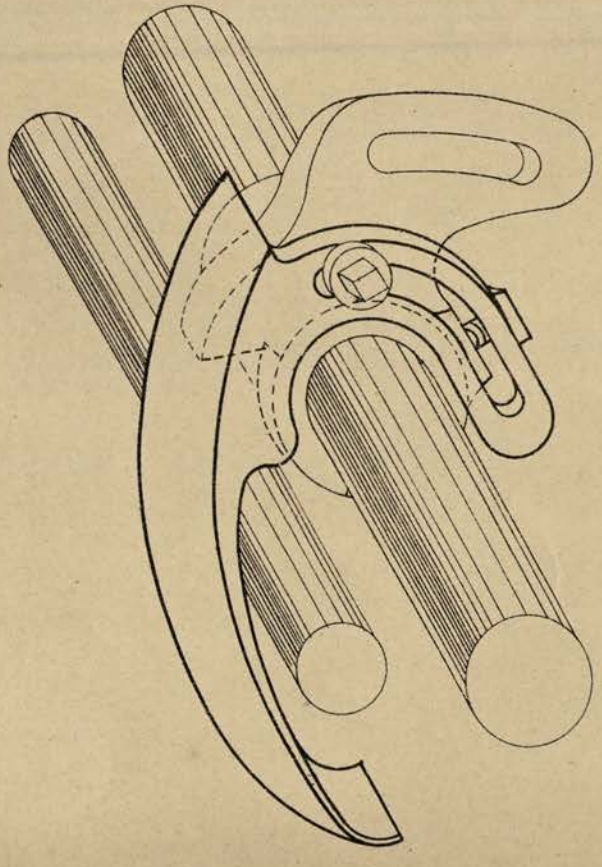
Weller & Graham Ltd Litho London.

FIG. 1.



VIEW OF FALLER STOP WITHOUT GUARD

FIG. 2.



VIEW OF FALLER STOP WITH GUARD

IMPROVED GUARD FOR FALLER STOPS OF SELF-ACTING MULES

516 8 06

Wellier & Graham, Ltd Litho. London.

MESSRS. HALL & JONES' GUARD FOR QUADRANT PINIONS OF SELF-ACTING MULES

FIG. 1.

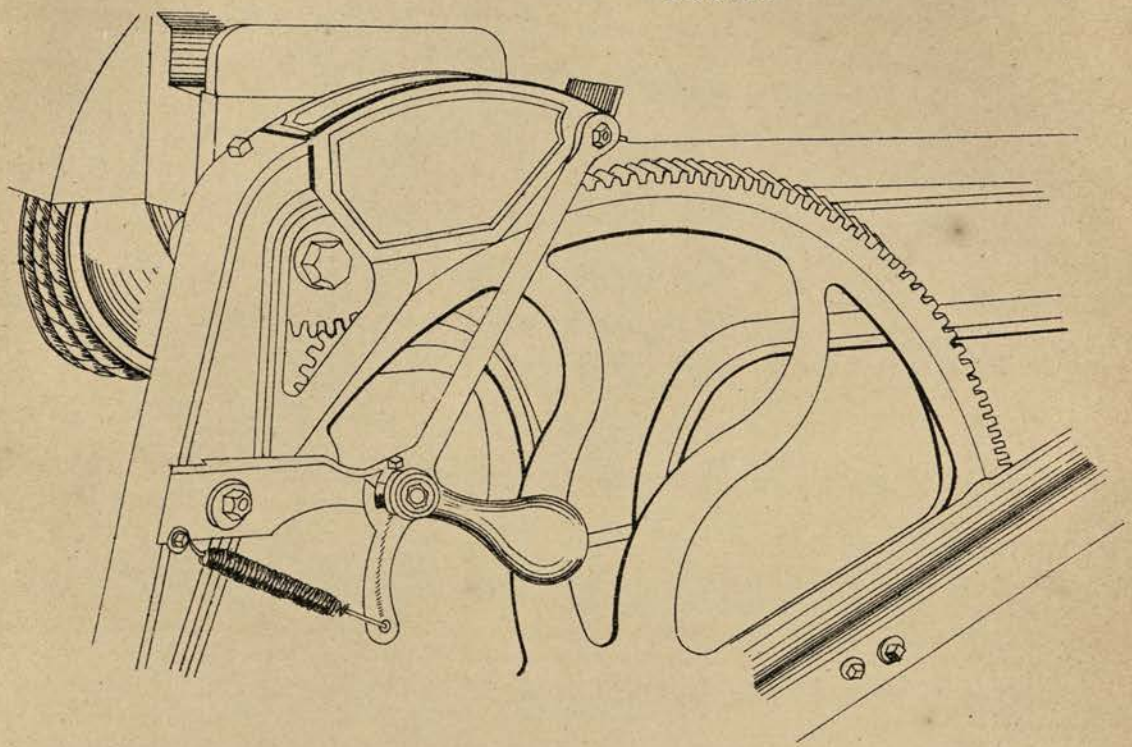
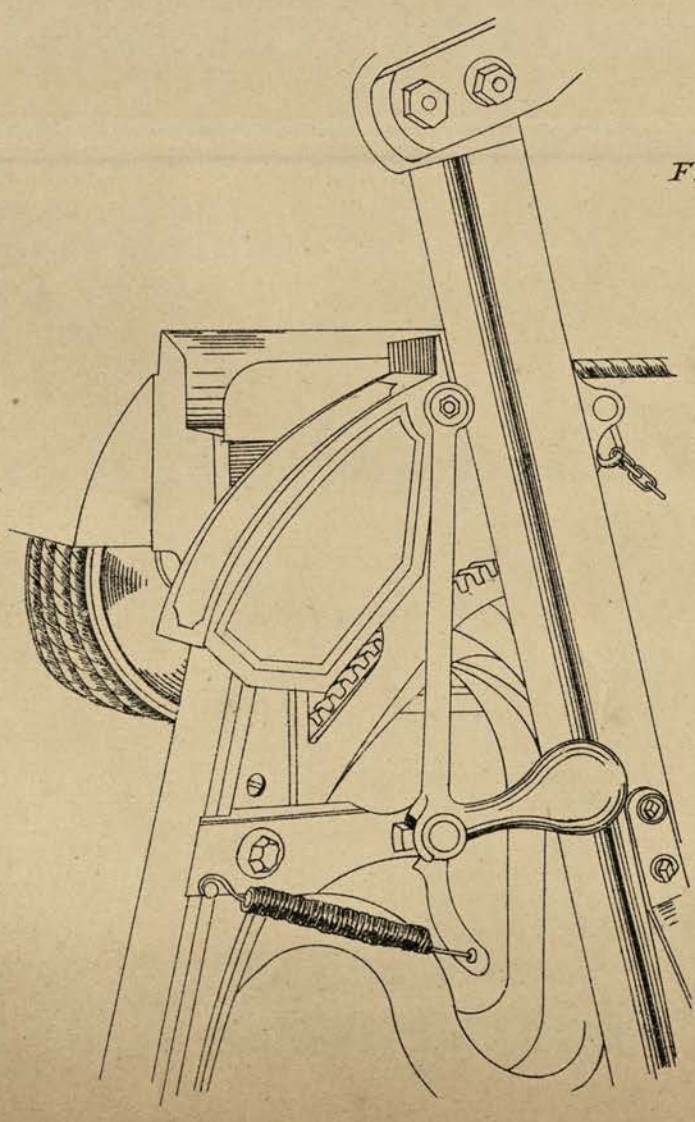


FIG. 2.



Weller & Graham Ltd Litho London

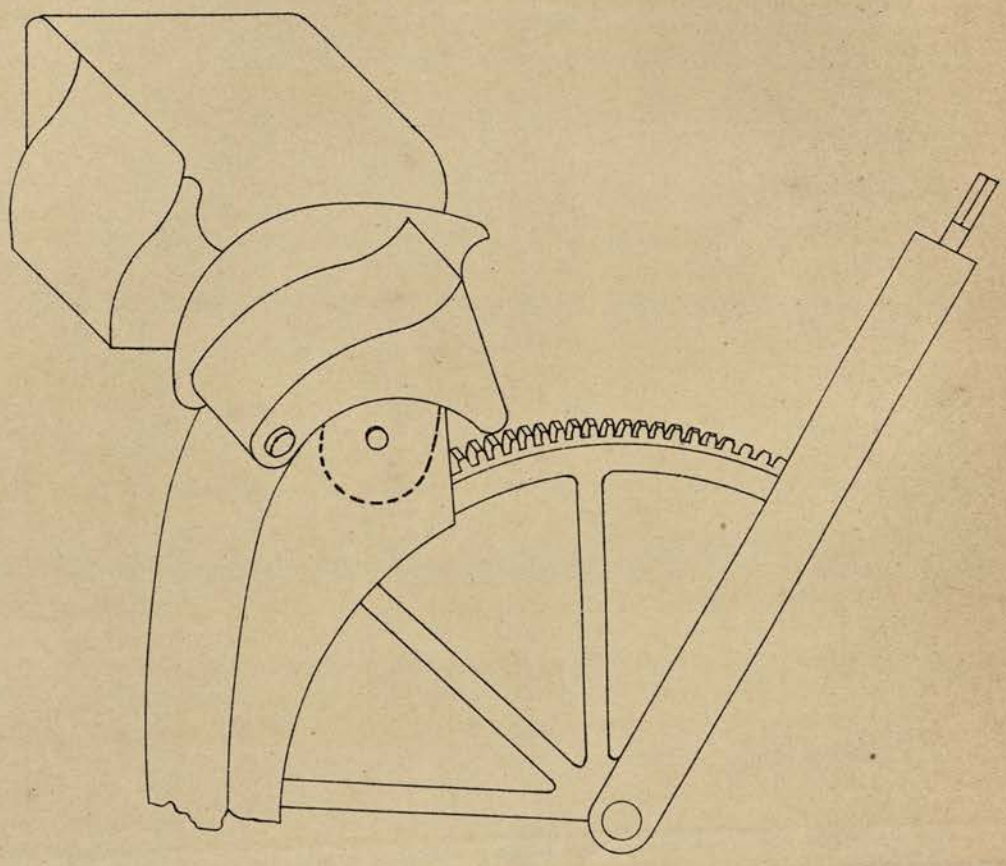


FIG. 1.

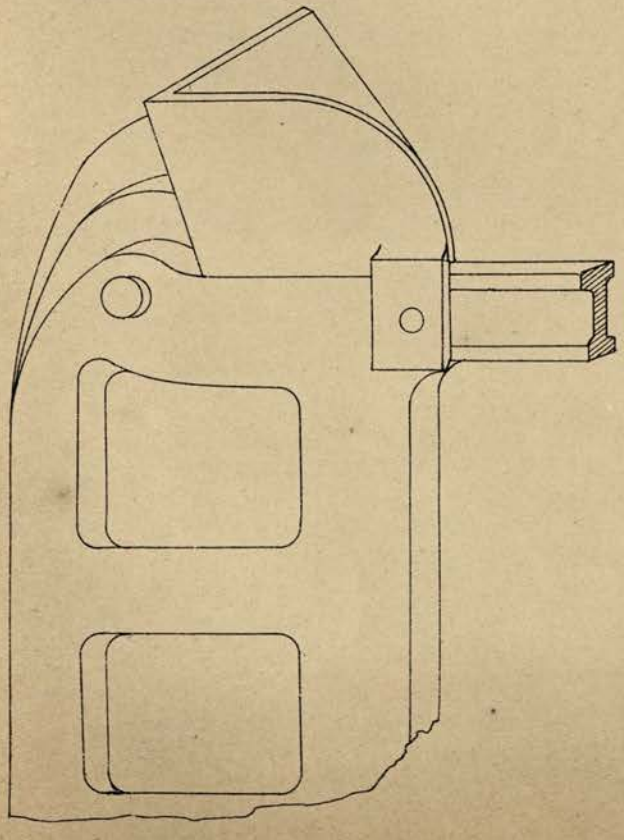


FIG. 2.

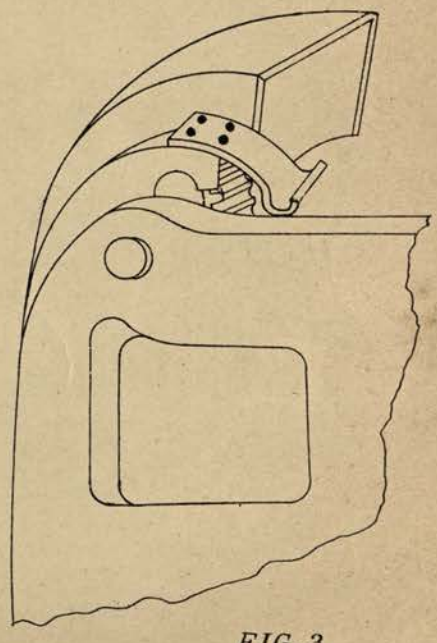


FIG. 3.

METHODS OF FENCING MORE SECURELY QUADRANT PINIONS OF OLD SELF-ACTING MULES

510.8.06

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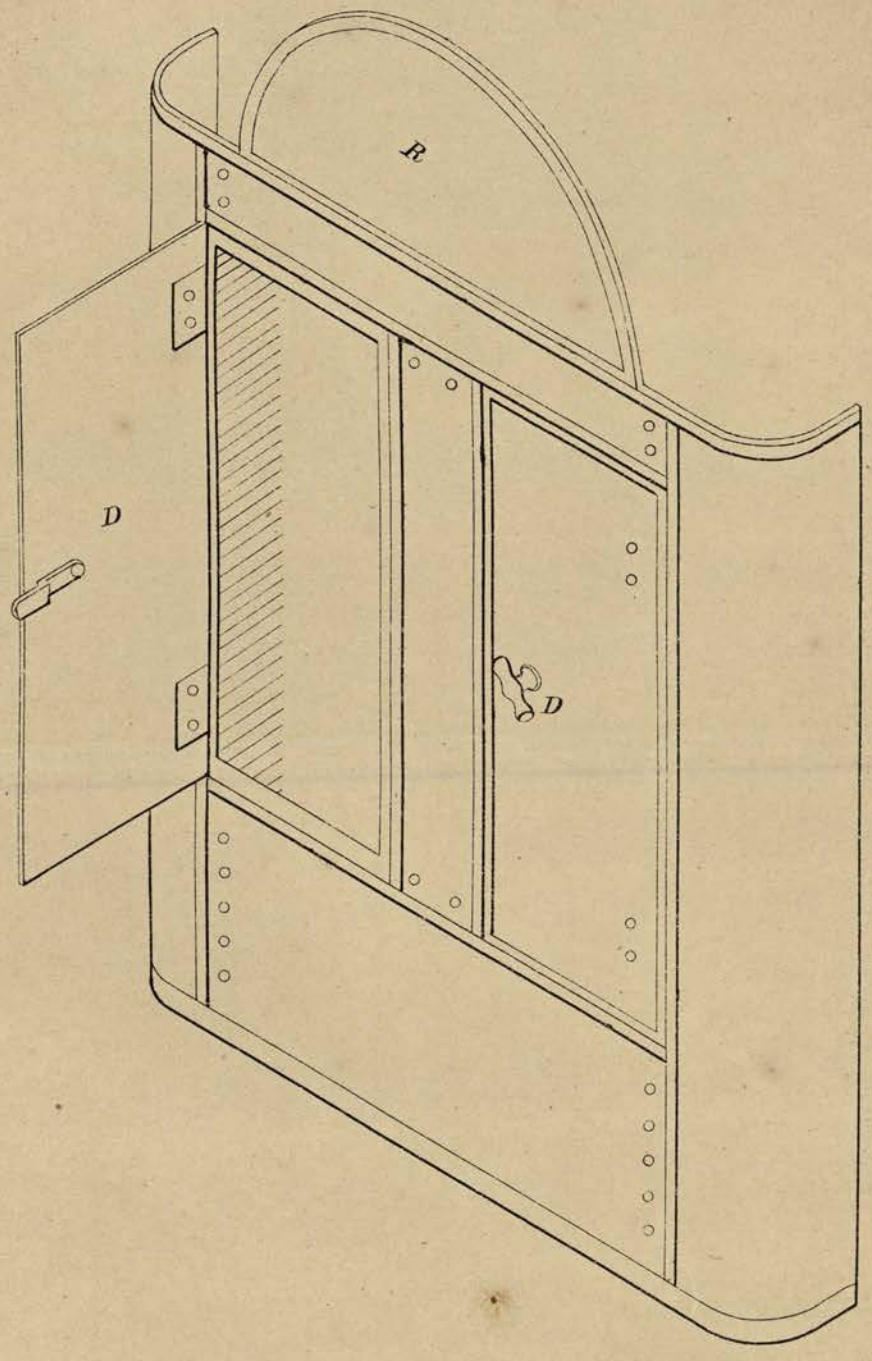
SELF-ACTING MULES.

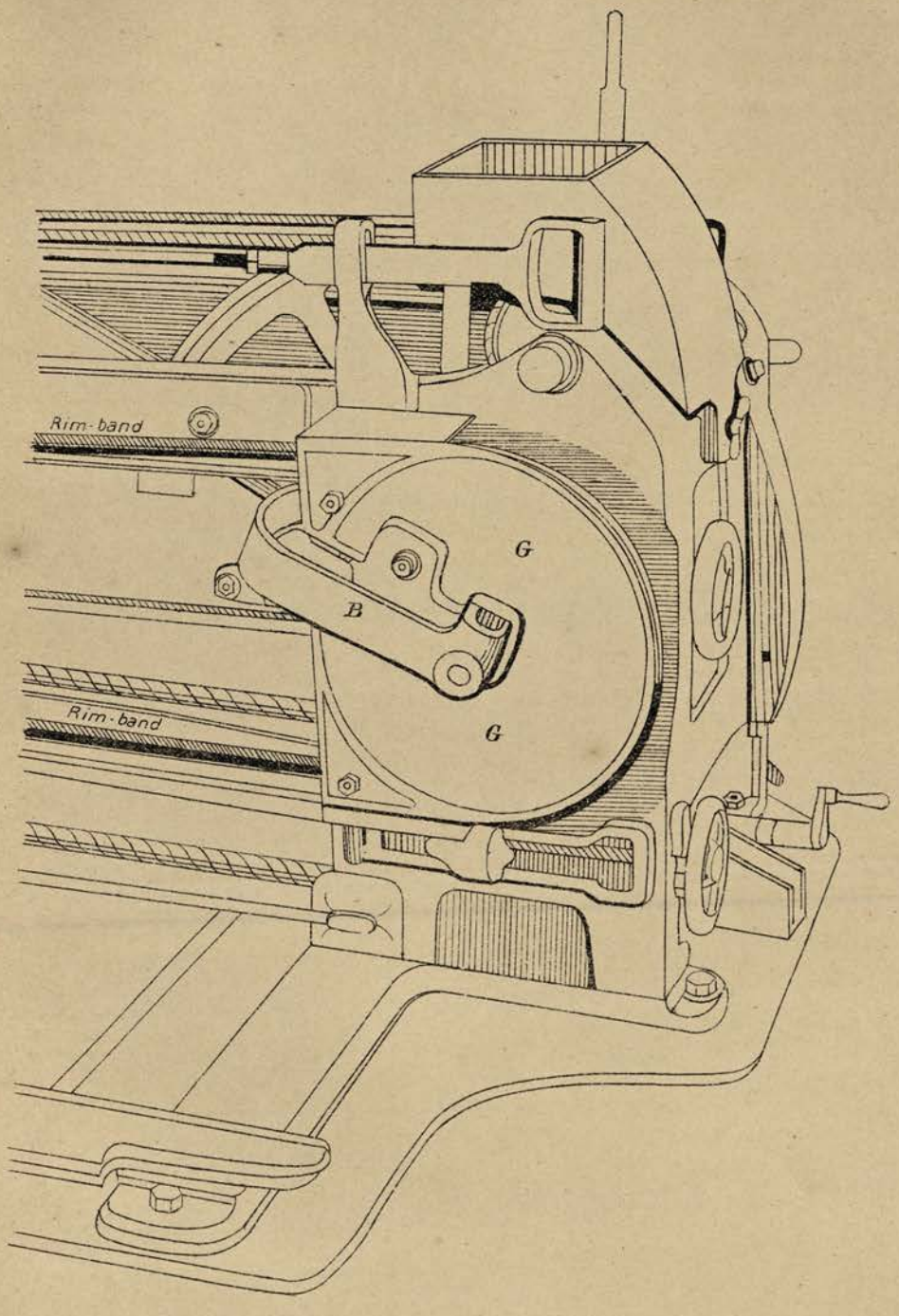


Sheet-iron guard for headstock gearing and rim-band pulley.
D.D doors for oiling &c. R. guard for rim-band pulley.

5/0.8.06

Weller & Graham, Ltd Litho. London.

SELF-ACTING MULES



Shows a method of fencing the rim-band tightening pulley on the tail-piece of headstock by means of a fender bracket B and guard G.

(Where the pulley is not an armless or plate wheel, the arms should be covered by a guard, as shown above, or, where no bracket exists, by a similar guard attached to the pivot stud)

510.8.96

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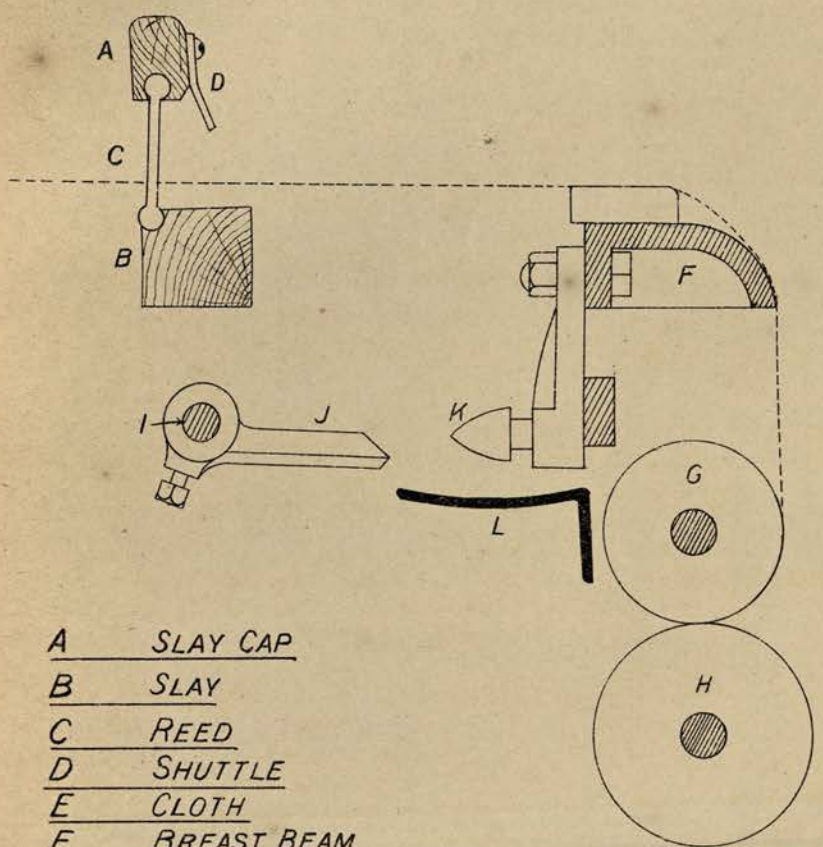
Shri Brihad Bhartiya Samaj

on 24 February, 2020

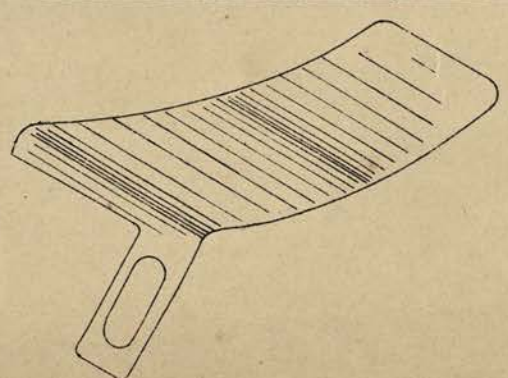
FIG. 1.



A	SLAY CAP
B	SLAY
C	REED
D	SHUTTLE
E	CLOTH
F	BREAST BEAM
G	TAKING UP ROLLER
H	CLOTH ROLLER
I	STOP ROD
J	DUCK BILL
K	HEATER
L	GUARD FOR DUCKBILL & HEATER

DIAGRAM OF LOOSE REED LOOM SHEWING DUCKBILL & HEATER.

FIG. 2.



GUARD FOR DUCKBILL & HEATER

Weller & Graham, Ltd Litho. London.